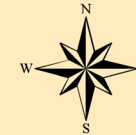




Planning and Assistance Division

GENERAL BASIN MAP

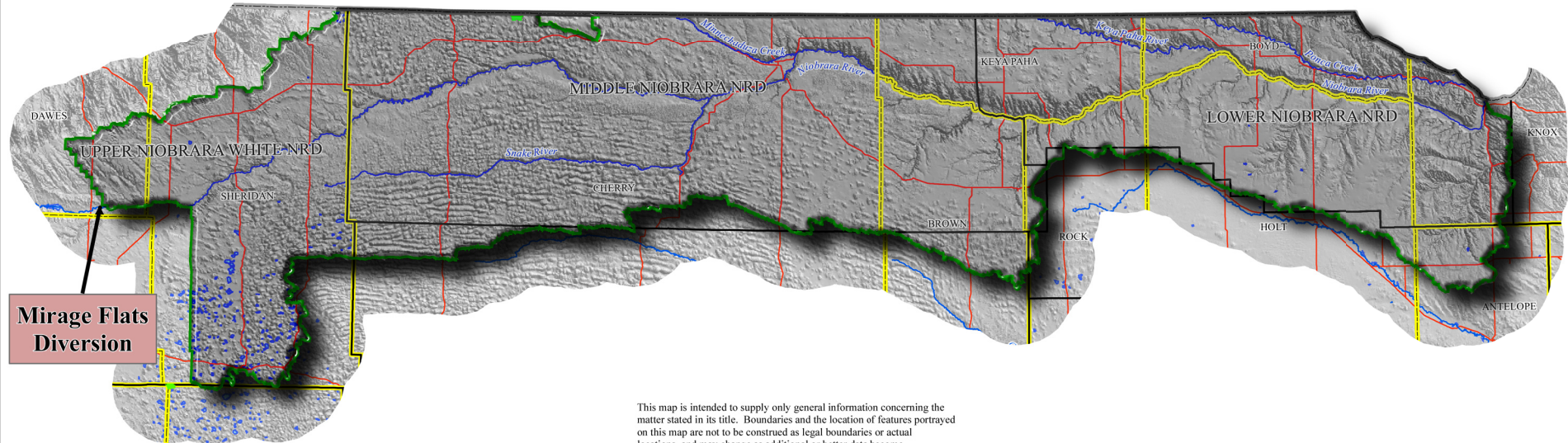
NIOBRARA RIVER BASIN BELOW MIRAGE FLATS DIVERSION



Explanation

- | | | |
|----------------|--------------------------|--------------|
| Niobrara Basin | Cultural Features | Highways |
| Lakes | County Boundary | NRD Boundary |
| | State Boundary | |

Location Map

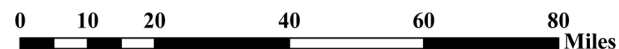


**Mirage Flats
Diversion**

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Figure NI-1.

DRAFT



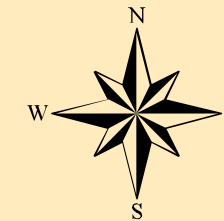
Base map produced by Josh Lear, February 4, 2005
Base map approved February 4, 2005
General basin map produced by Shuhai Zheng, October 13, 2005.



Planning and Assistance Division

General Surface Water Features

NIOBRARA RIVER BASIN BELOW MIRAGE FLATS DIVERSION



Explanation

Surface Water Features

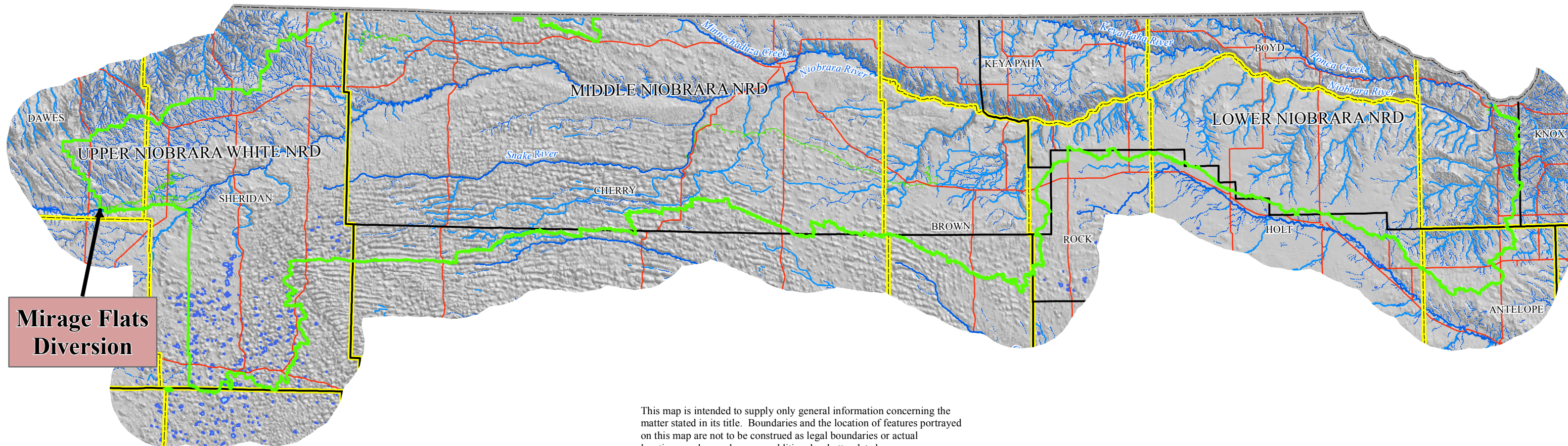
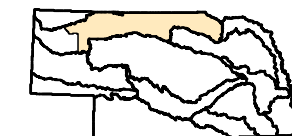
- Rivers
- Intermittent Streams
- Canals/Ditches
- Lakes

Cultural Features

- Niobrara Basin
- County Boundary
- State Boundary

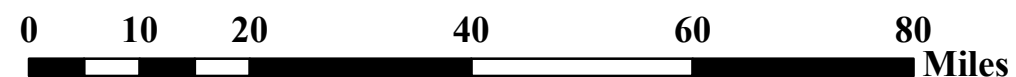
- Highways
- NRD Boundary

Location Map



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Figure LN-2.



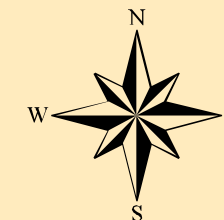
Base map produced by Josh Lear, February 4, 2005
Base map approved February 4, 2005
General surface water features map produced by Shuhai Zheng, October 13, 2005.



Planning and Assistance Division

Precipitation Gages

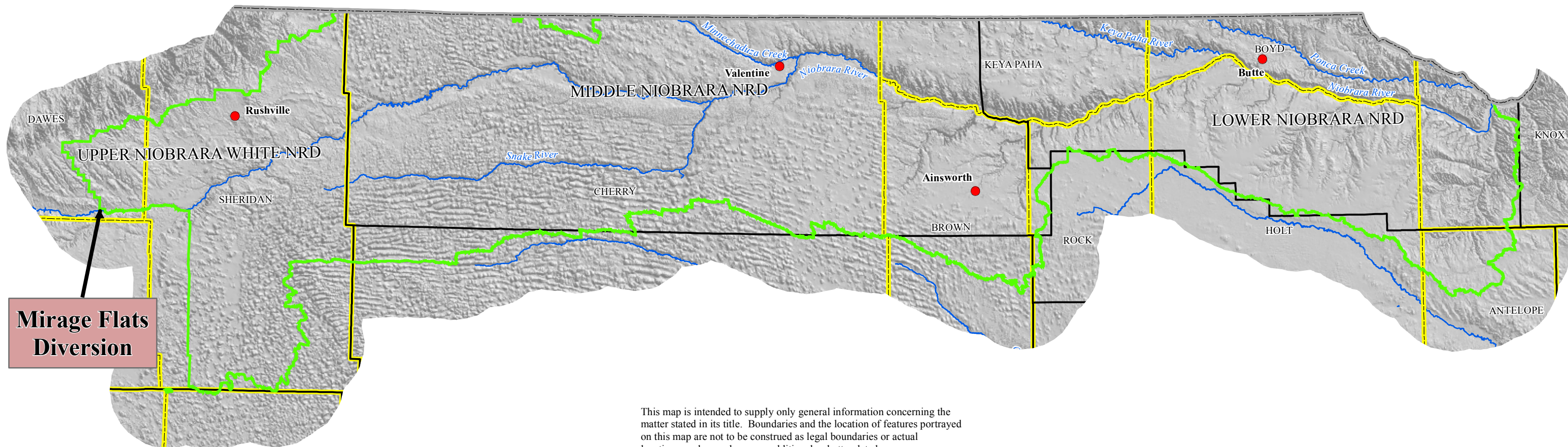
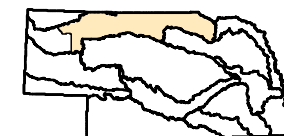
NIOBRARA RIVER BASIN BELOW MIRAGE FLATS DIVERSION



Explanation

- | | |
|---------------------|--------------------------|
| Niobrara Basin | Cultural Features |
| Precipitation Gages | County Boundary |
| | State Boundary |
| | NRD Boundary |

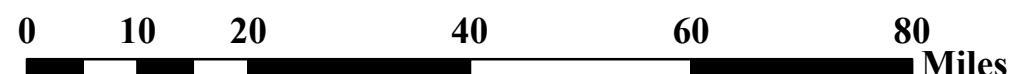
Location Map



**Mirage Flats
Diversion**

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Figure LN-3.



Base map produced by Josh Lear, February 4, 2005
Base map approved February 4, 2005
Precipitation gages map produced by Jeff Shafer, October 19, 2005.

Figure LN-4. Annual Precipitation at Ainsworth.

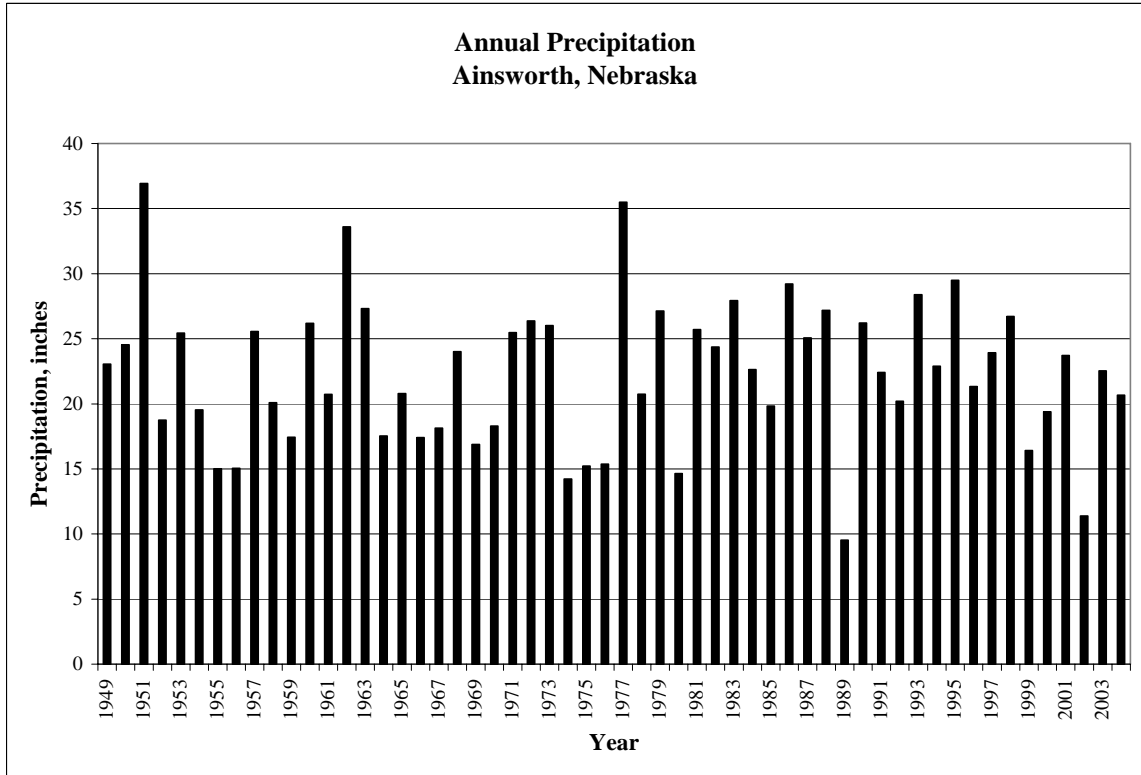


Figure LN-5. Growing Season (May-September) Precipitation at Ainsworth.

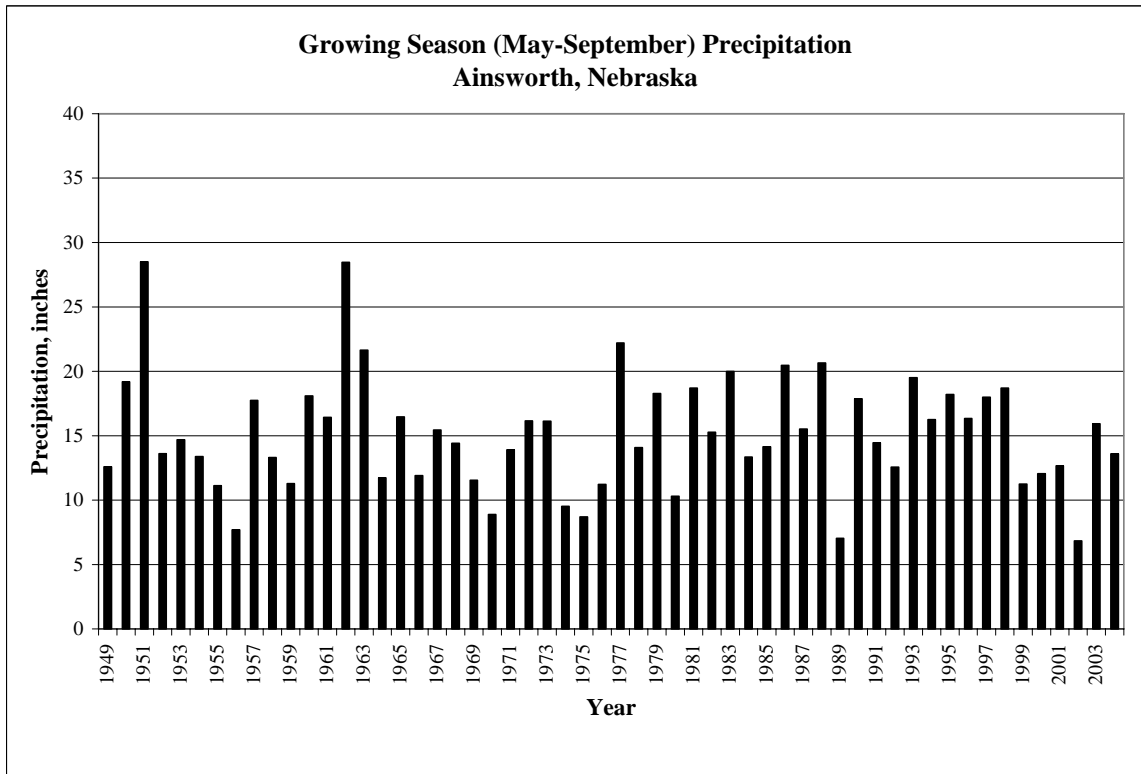


Figure LN-6. Annual Precipitation at Butte.

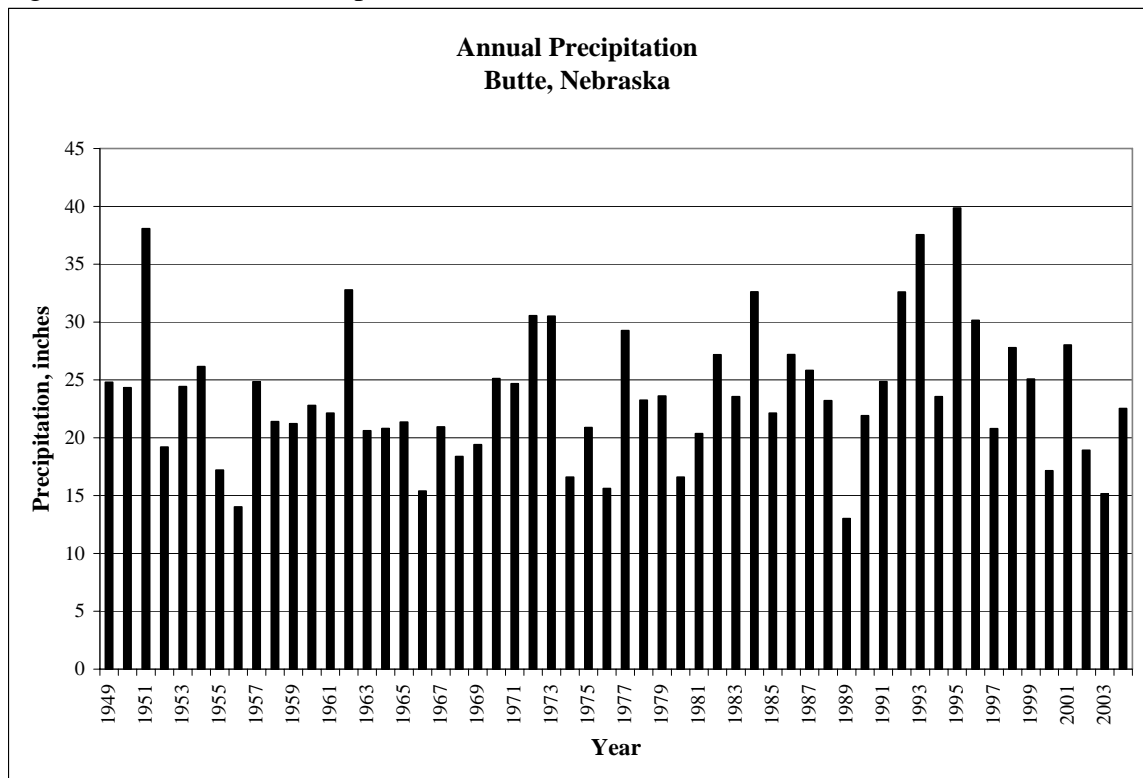


Figure LN-7. Growing Season (May-September) Precipitation at Butte.

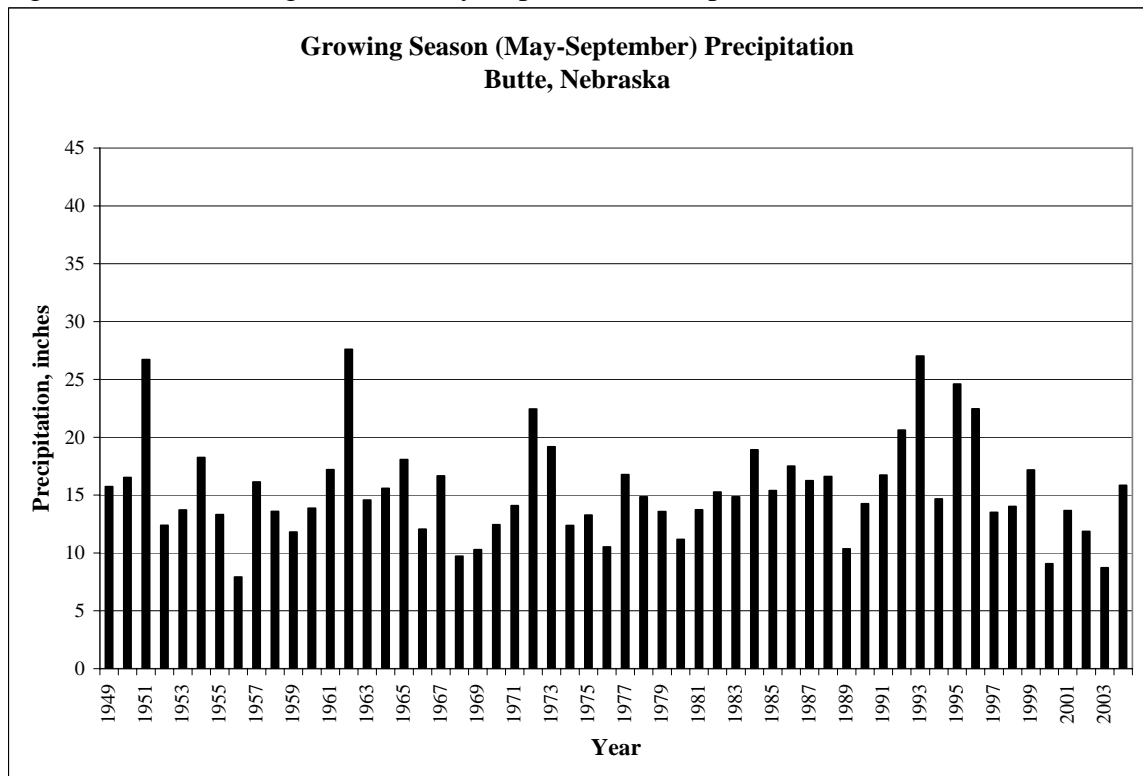


Figure LN-8. Annual Precipitation at Rushville.

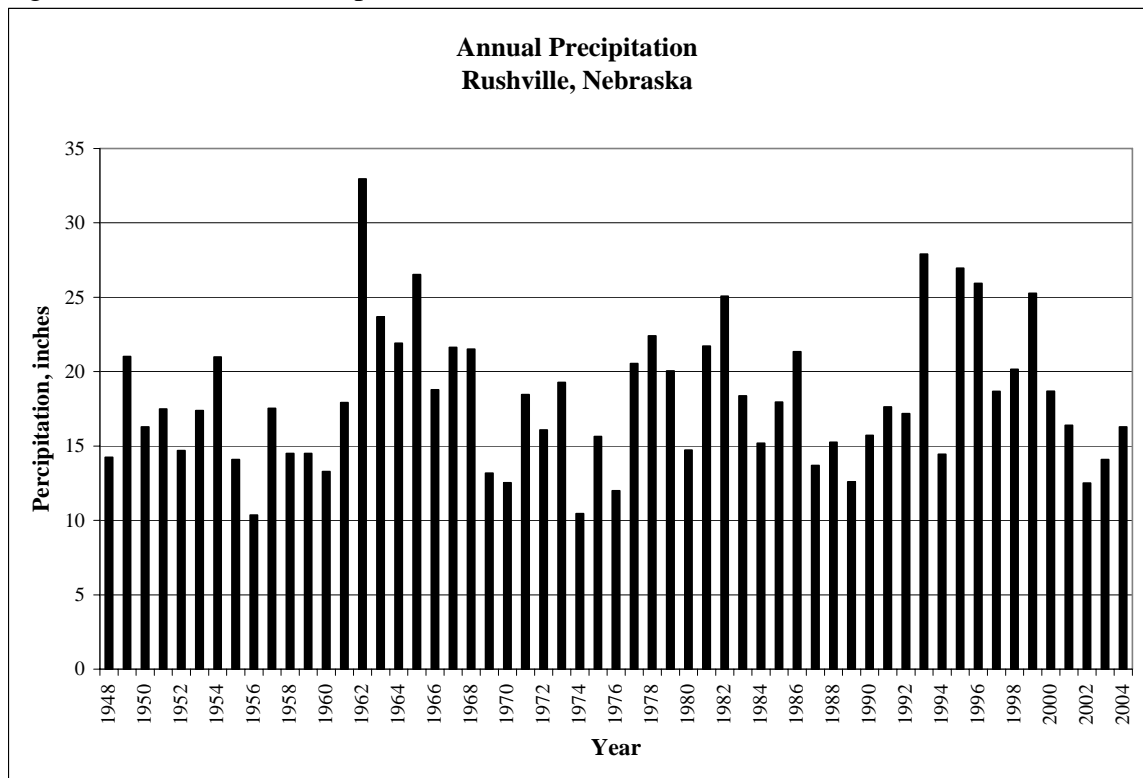


Figure LN-9. Growing Season (May-September) Precipitation at Rushville.

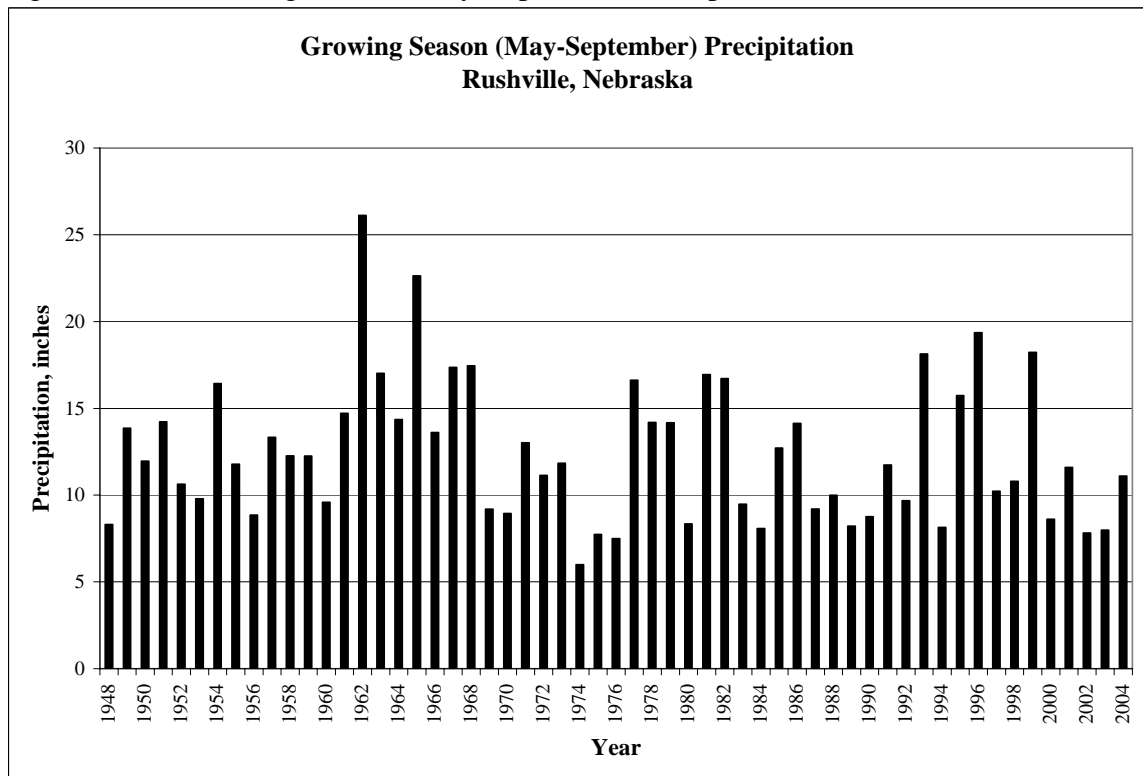


Figure LN-10. Annual Precipitation at Valentine.

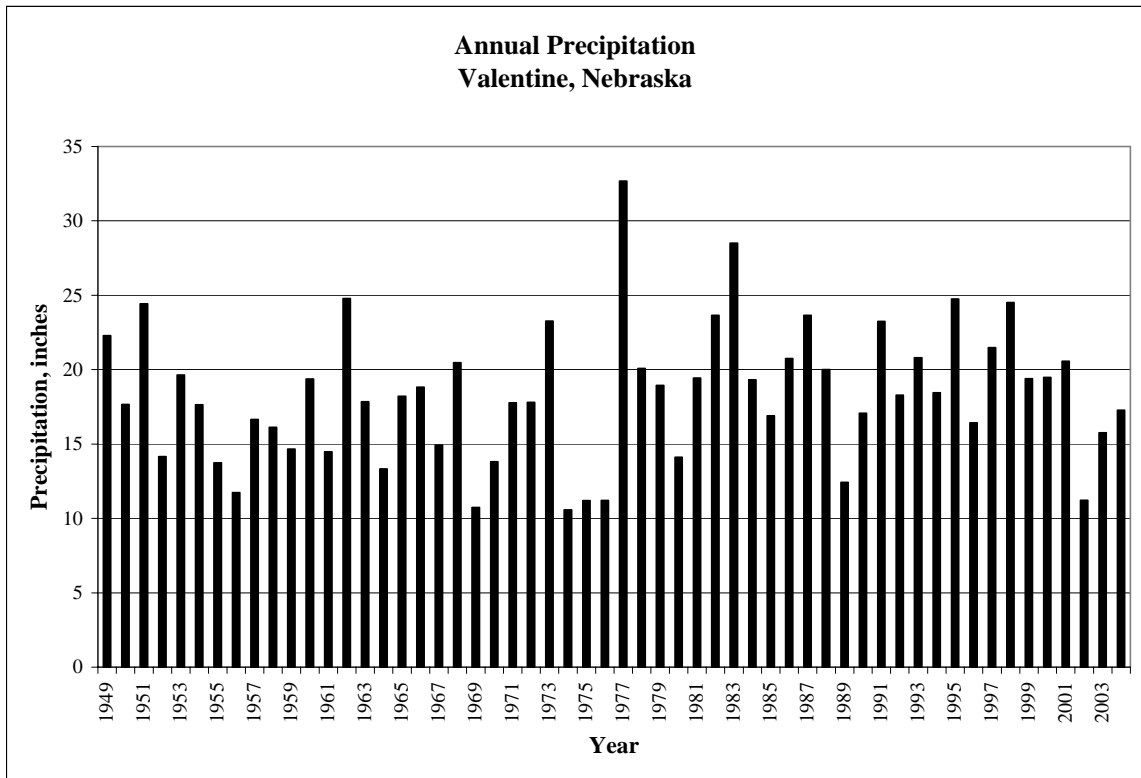


Figure LN-11. Growing Season (May-September) Precipitation at Valentine.

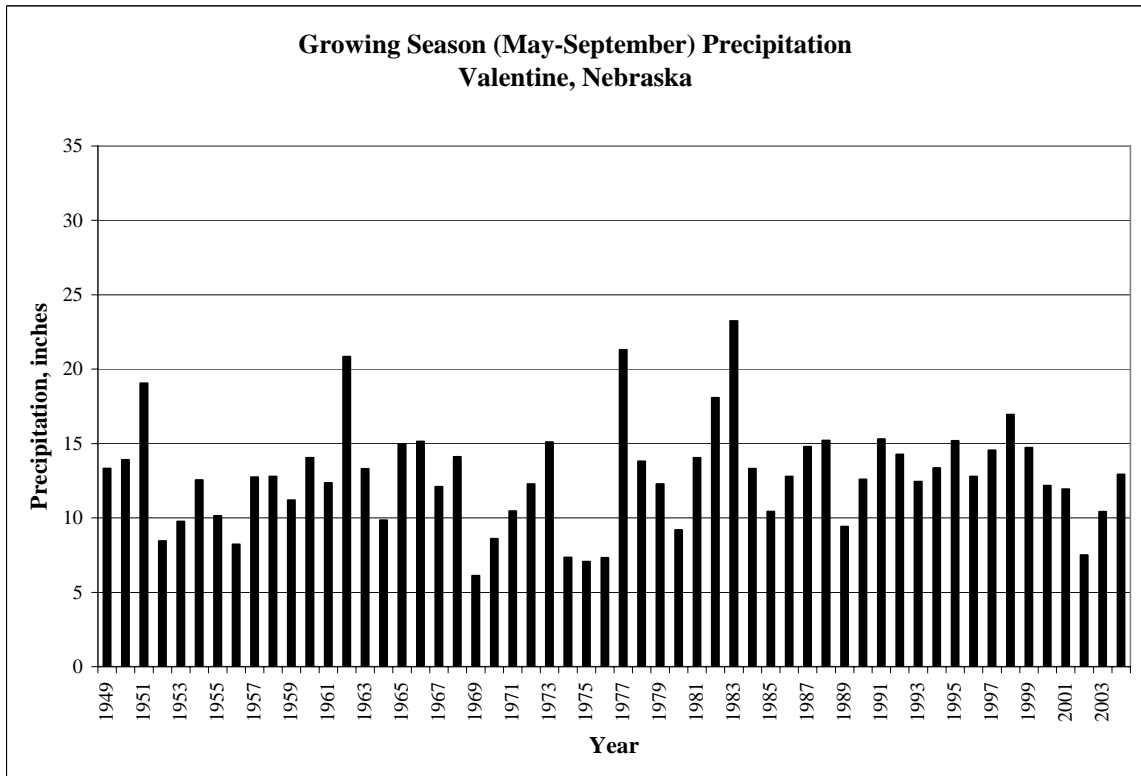


Table LN-1. – Aquifers in unconsolidated surficial deposits (modified from Cronin and Newport, 1995; Souders, 1976; Newport and Krieger, 1959)

System	Hydrogeologic unit	Character and description	Maximum thickness, in feet	Hydrogeologic characteristics
Quaternary	Recent to Late Pleistocene Deposits	Gravel, sand, silt, and clay. Includes dune sand and loess in upland areas and thin alluvial deposits below the floors of principal valleys.	150	An important source of water where saturated. Beds of sand and gravel below bottom lands yield small to moderate amounts of water to wells. Some deposits mantling upland areas may also serve as water sources. Variable water quality, generally suitable for livestock and domestic use. Water from river valleys may contain more dissolved iron.
	Early Pleistocene Deposits	Gravel, sand, silt and clay in upland areas. Generally south of the Niobrara River.	175	Thick saturated deposits of sand and gravel yield moderate to large quantities of water to wells.
	Dune Sand	Wind-blown very fine to fine sand.	200	Yields large supplies to stock wells tapping thick sequences of saturated sand.
	Grand Island Formation	Cross-bedded sand and gravel deposits derived mostly from granitic crystalline rocks.	100	Yields moderately large to large amounts of water tapping thick sequences of saturated material.
	Holdrege Formation	Sand and gravel made up mostly of reworked Tertiary material and some quartz and granitic crystalline material.	50	Yields large supplies of water.

Table LN-2. – Characteristics of bedrock aquifers (modified from Cronin and Newport, 1995; Souders, 1976; Newport and Krieger, 1959)

System	Hydrogeologic unit	Character and description	Maximum thickness, in feet	Hydrogeologic characteristics
Tertiary	Ogallala Group	Fine to medium sand and silt containing volcanic ash; calcareous in places. Some lower sands are cemented with silica. Contains fossil seeds and vertebrates.	400	Yield small to moderately large amounts of water to wells tapping thick beds of saturated material.
	Miocene (?) Silt Beds	Silt, clay, siltstone and claystone beds containing lime concretions in places and may be gravelly in lower part.	80	Source of water to stock and domestic wells in some places. Excellent water quality.
	Brule Formation	Sandy siltstone.	350	Not a source of water, but test drilling indicates that water is locally present under artesian pressure.
Cretaceous	Pierre Shale	Claystone, Shale, chalk to chalky shale.	800	Yields little or no water to wells, generally very poor quality. Some wells tapping thin zone of saturation in overlying rocks extend into upper Pierre shale to provide storage space for water draining from saturated zone.
	Niobrara Formation	Chalk, shaly chalk, shale and limestone.	220	Not an important water source. Secondary porosity in upper part may provide water to wells in Missouri River valley.
	Codell Sandstone Member of the Carlile Shale	Sandstone, siltstone and clayey siltstone.	60	Yields mineralized water. Satisfactory for livestock and domestic purposes.

Table LN-2. – Characteristics of bedrock aquifers--Continued

System	Hydrogeologic unit	Character and description	Maximum thickness, in feet	Hydrogeologic characteristics
	Dakota Sandstone	Fine to coarse sandstone interbedded with siltstone, clay, carbonaceous shale, and sandy shale.	750	Good source of water with some flowing wells. Yields small to moderate amounts of water that is mineralized. Water is good quality for livestock but limited suitability for domestic use.
Permian to Cambrian	Undifferentiated Sedimentary Rocks	Mostly limestone and dolomite with some sandstone and shale.	250	Not a source of water. But some units would probably yield water to wells, but water would likely be highly mineralized.



Planning and Assistance Division

Bedrock Geology

NIOBRARA RIVER BASIN BELOW MIRAGE FLATS DIVERSION

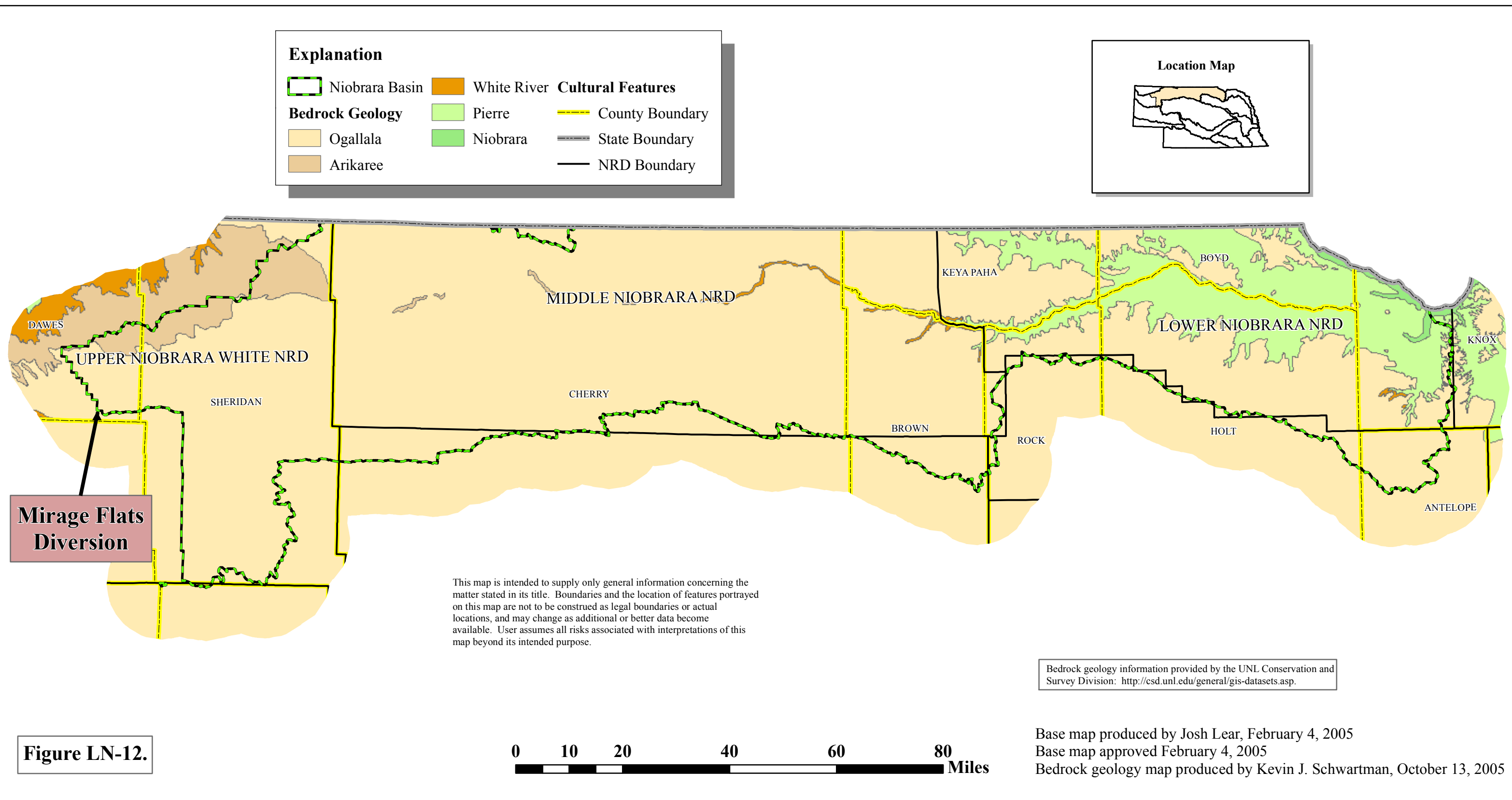
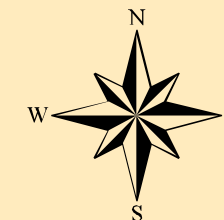
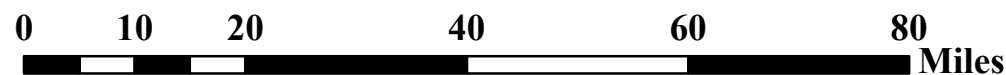


Figure LN-12.

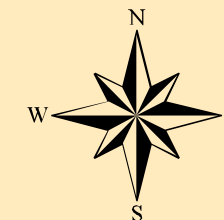




Planning and Assistance Division

Saturated Thickness

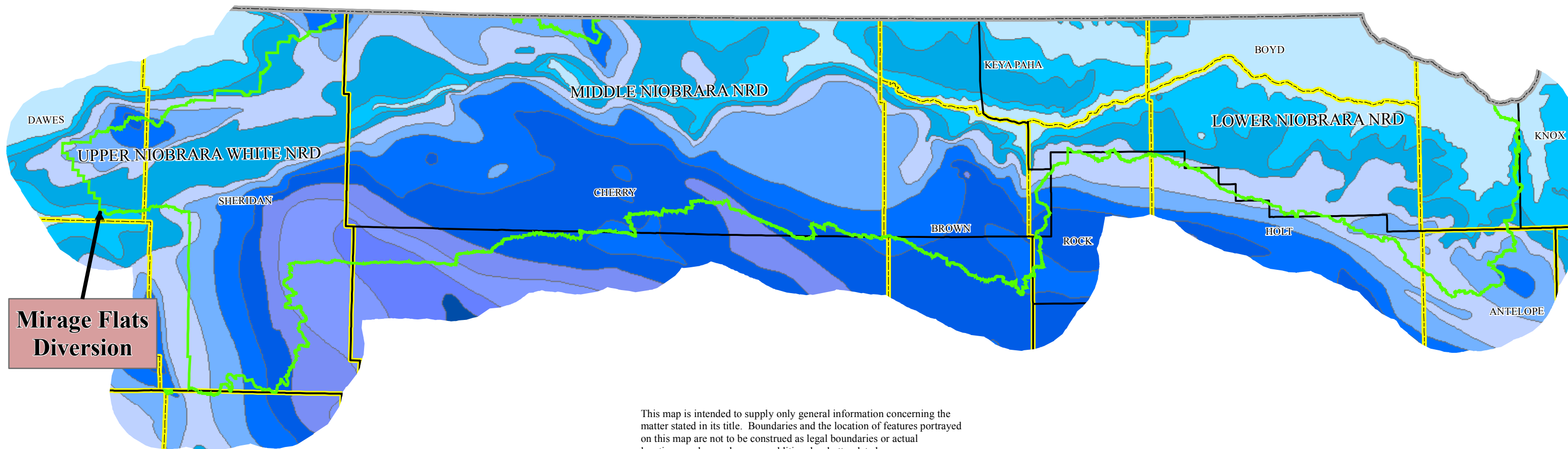
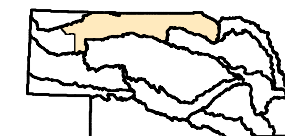
NIOBRARA RIVER BASIN BELOW MIRAGE FLATS DIVERSION



Explanation

Niobrara Basin	100 ft.	500 ft.	900 ft.	Cultural Features
Saturated Thickness	200 ft.	600 ft.	1000	County Boundary
Absent	300 ft.	700 ft.		State Boundary
0 ft.	400 ft.	800 ft.		NRD Boundary

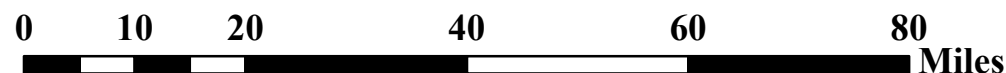
Location Map



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Saturated thickness information provided by the UNL Conservation and Survey Division: <http://csd.unl.edu/general/gis-datasets.asp>.

Figure LN-13.



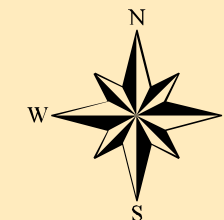
Base map produced by Josh Lear, February 4, 2005
Base map approved February 4, 2005
Saturated thickness map produced by Kevin J. Schwartman, October 13, 2005



Planning and Assistance Division

Depth to Water

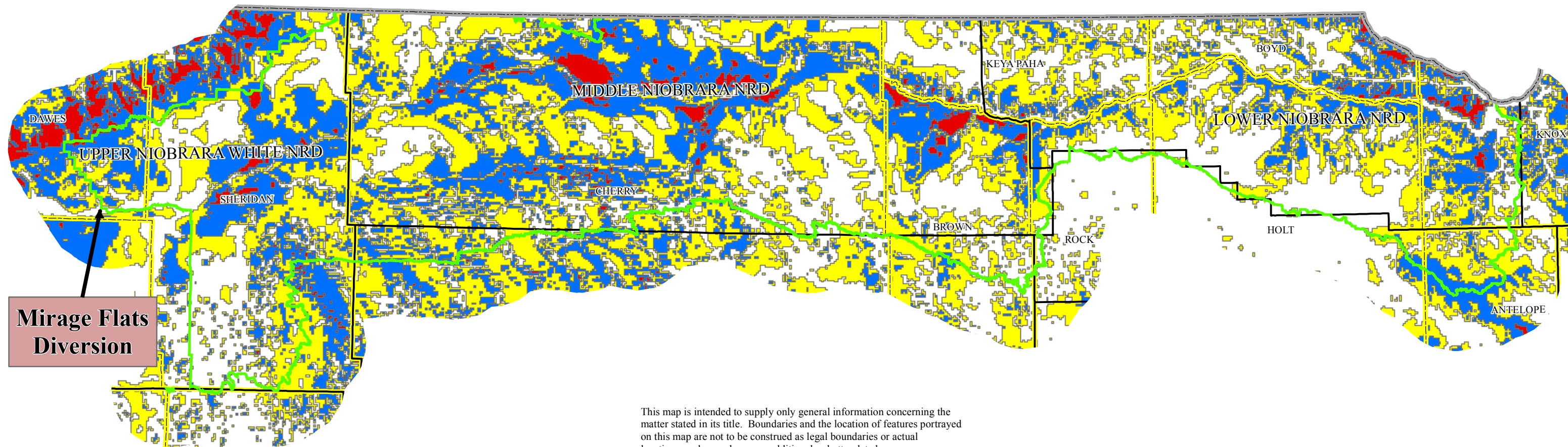
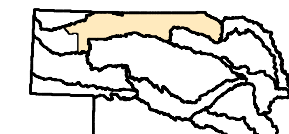
NIOBRARA RIVER BASIN BELOW MIRAGE FLATS DIVERSION



Explanation

Niobrara Basin	50 - 100 feet	Cultural Features
Depth to Water 100-200 feet	> 200 feet	County Boundary
0 - 50 feet		State Boundary
		NRD Boundary

Location Map

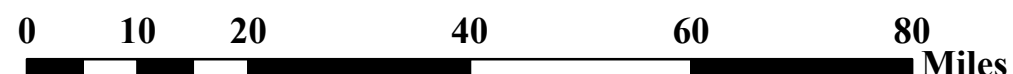


Mirage Flats
Diversion

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Depth to water information provided by the UNL Conservation and Survey Division: <http://csd.unl.edu/general/gis-datasets.asp>.

Figure LN-14.



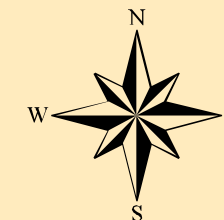
Base map produced by Josh Lear, February 4, 2005
Base map approved February 4, 2005
Bedrock geology map produced by Kevin J. Schwartman, October, 13, 2005



Planning and Assistance Division

Transmissivity

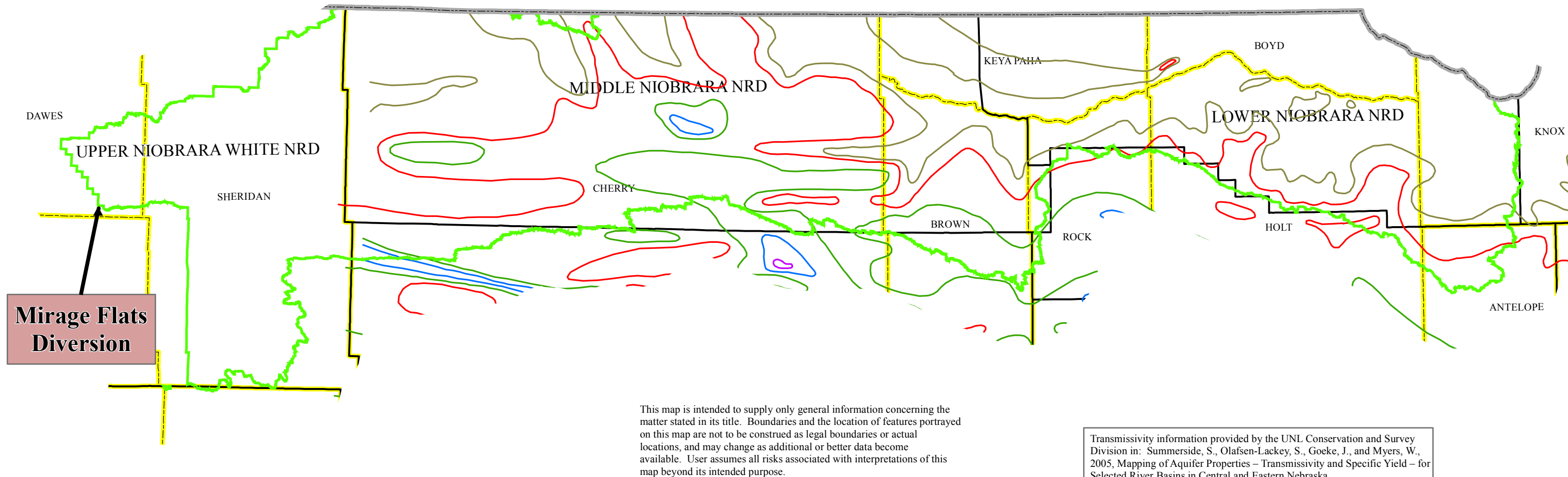
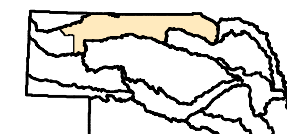
NIOBRARA RIVER BASIN BELOW MIRAGE FLATS DIVERSION



Explanation

Niobrara Basin	100	Cultural Features
Transmissivity	150	County Boundary
Thousands of gal/day/ft	200	State Boundary
20	250	NRD Boundary
50	300	

Location Map



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Transmissivity information provided by the UNL Conservation and Survey Division in: Summerside, S., Olafsen-Lackey, S., Goeke, J., and Myers, W., 2005, Mapping of Aquifer Properties – Transmissivity and Specific Yield – for Selected River Basins in Central and Eastern Nebraska.

Figure LN-15.

0 10 20 40 60 80 Miles

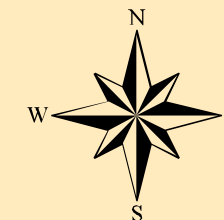
Base map produced by Josh Lear, February 4, 2005
Base map approved February 4, 2005
Transmissivity map produced by Kevin J. Schwartzman, October 13, 2005



Planning and Assistance Division

Specific Yield

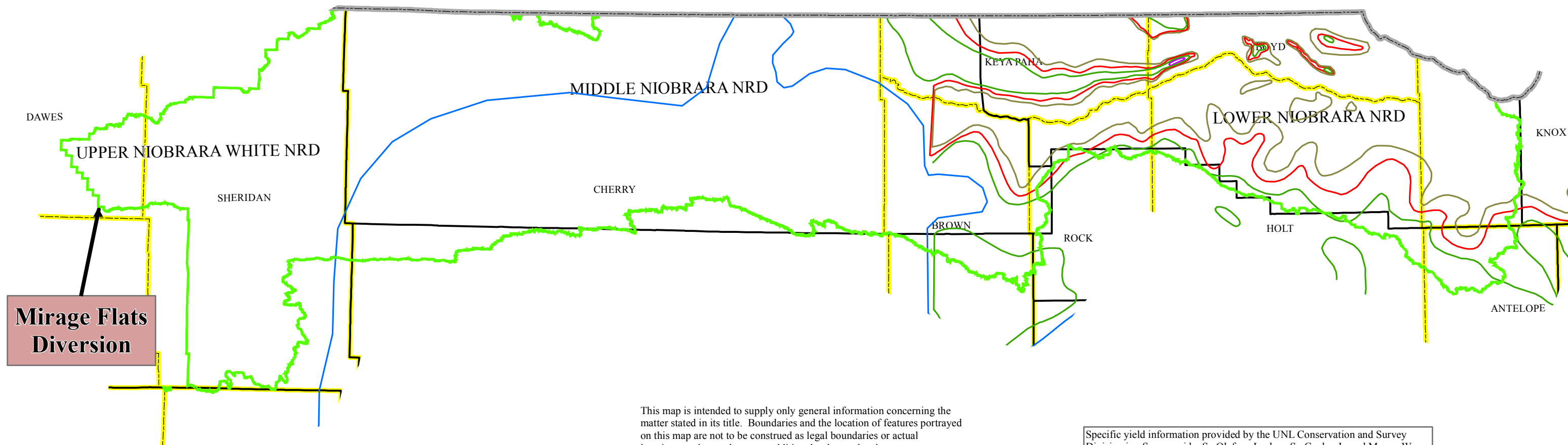
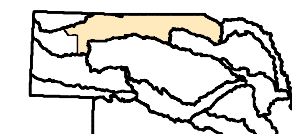
NIOBRARA RIVER BASIN BELOW MIRAGE FLATS DIVERSION



Explanation

Niobrara Basin	15	Cultural Features
Specific Yield (Percent) 5	17	County Boundary
10	20	State Boundary
	25	NRD Boundary

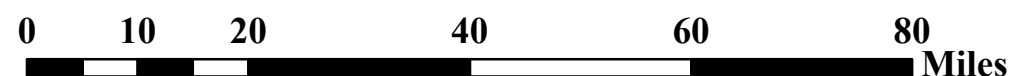
Location Map



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Specific yield information provided by the UNL Conservation and Survey Division in: Summerside, S., Olafsen-Lackey, S., Goeke, J., and Myers, W., 2005, Mapping of Aquifer Properties – Transmissivity and Specific Yield – for Selected River Basins in Central and Eastern Nebraska.

Figure LN-16.



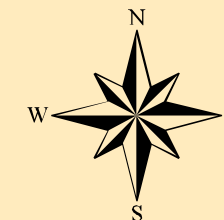
Base map produced by Josh Lear, February 4, 2005
Base map approved February 4, 2005
Specific yield map produced by Kevin J. Schwartman, October 13, 2005



Planning and Assistance Division

1995 Ground Water Table

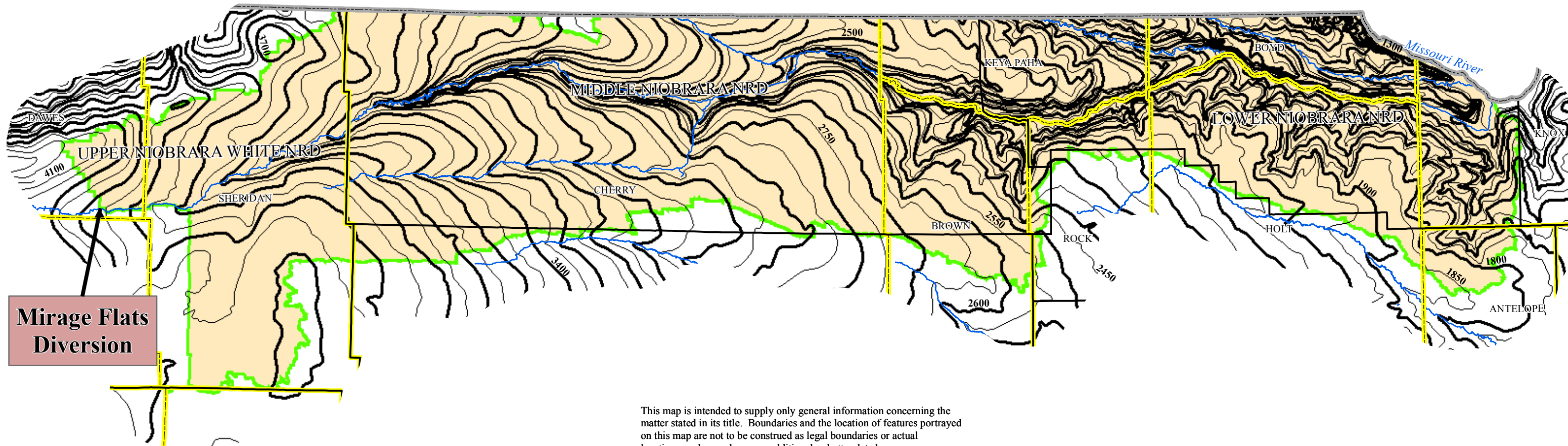
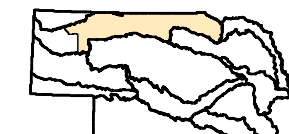
NIOBRARA RIVER BASIN BELOW MIRAGE FLATS DIVERSION



Explanation

- | | |
|------------------|-----------------------------|
| Niobrara Basin | Political Boundaries |
| 1995 Water Table | County Boundary |
| Major Streams | State Boundary |
| | NRD Boundary |

Location Map



**Mirage Flats
Diversion**

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Water table information provided by the UNL Conservation and Survey Division: <http://csd.unl.edu/general/gis-datasets.asp>.

Figure LN-17.

0 10 20 40 60 80 Miles

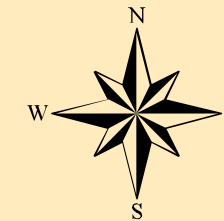
Base map produced by Josh Lear, February 4, 2005
Base map approved February 4, 2005
Water table map produced by Kevin J. Schwartzman, October 13, 2005



Planning and Assistance Division

Depletive Ground Water Wells

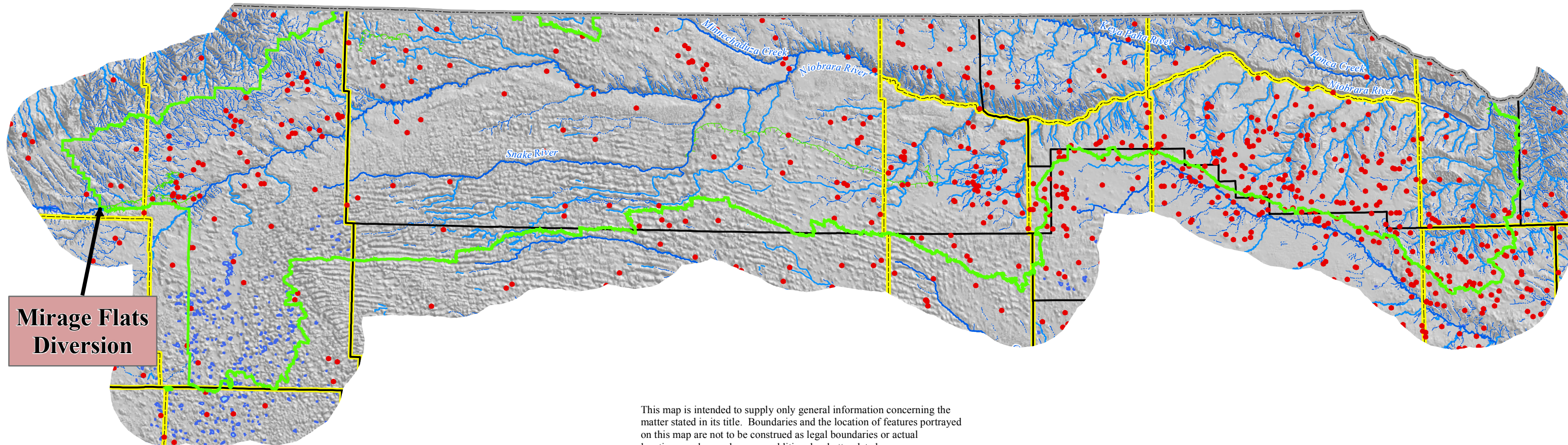
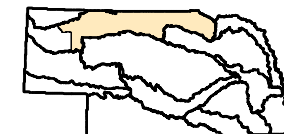
NIOBRARA RIVER BASIN BELOW MIRAGE FLATS DIVERSION



Explanation

- | | | |
|-------------------------------|----------------|--------------------------|
| • Depletive Wells | Lakes | Cultural Features |
| Surface Water Features | Niobrara Basin | County Boundary |
| Rivers | | State Boundary |
| Intermittent Streams | | NRD Boundary |
| Canals/Ditches | | |

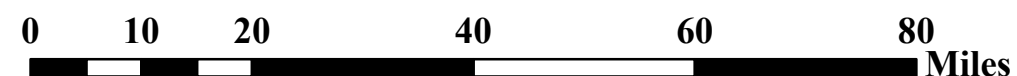
Location Map



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Depletive well information is from the DNR Registered Ground Water Well Database, as of January 2005 and include wells used for aquaculture, commercial, domestic, irrigation, public water supply, dewatering, stock and others except wells for non-consumptive uses.

Figure LN-18.



Base map produced by Josh Lear, February 4, 2005
Base map approved February 4, 2005
Depletive ground water wells map produced by Shuhai Zheng, October 13, 2005.



Planning and Assistance Division

High Capacity Wells by Completion Years

NIOBRARA RIVER BASIN BELOW MIRAGE FLATS DIVERSION

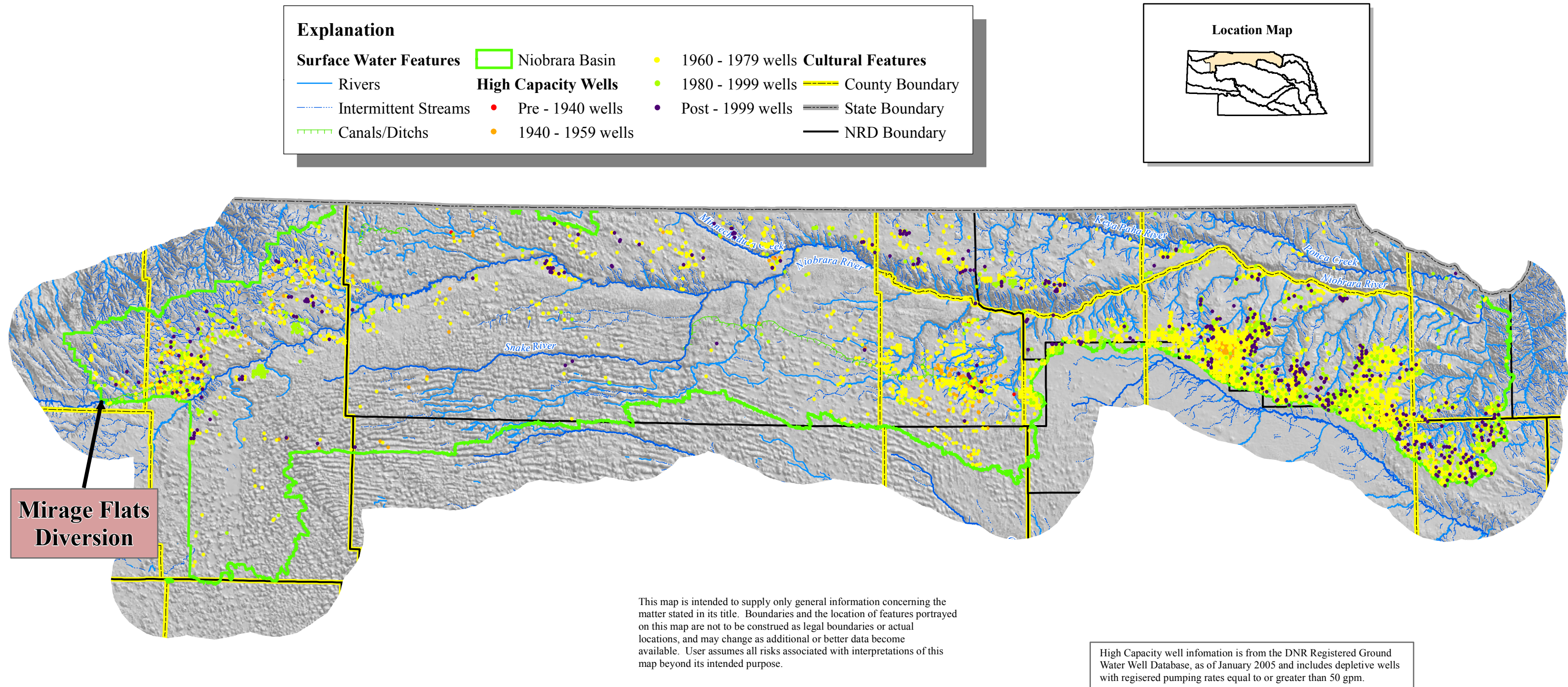
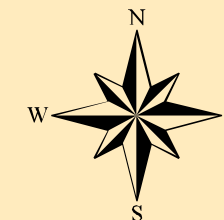
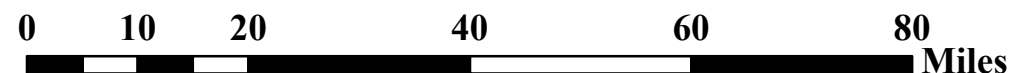
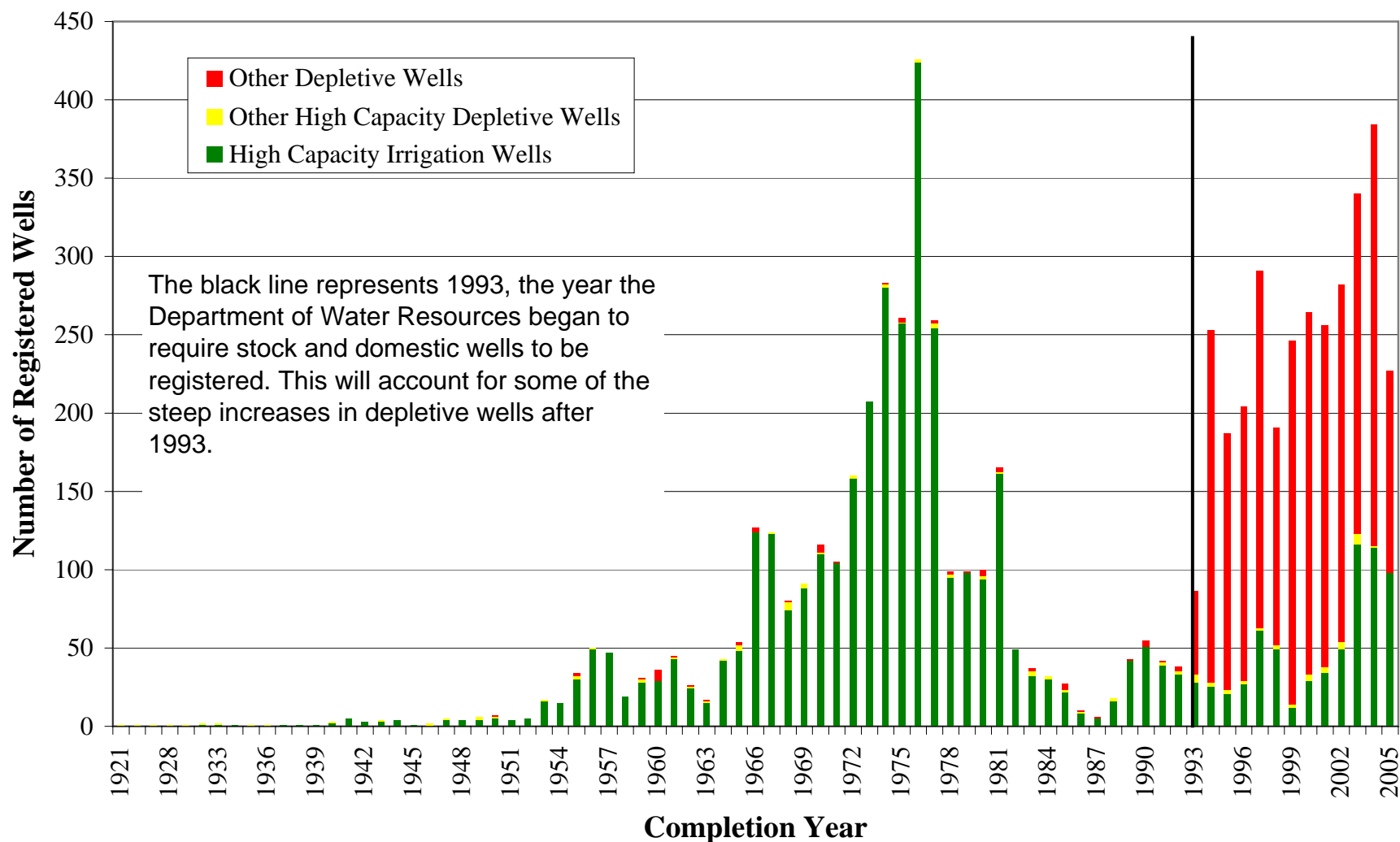


Figure LN-19.



Base map produced by Josh Lear, February 4, 2005
Base map approved February 4, 2005
High capacity wells map produced by Shuhai Zheng, November 10, 2005.

Registered Number of Depletive Wells by Completion Date Niobrara River Basin Below Mirage Flats Diversion

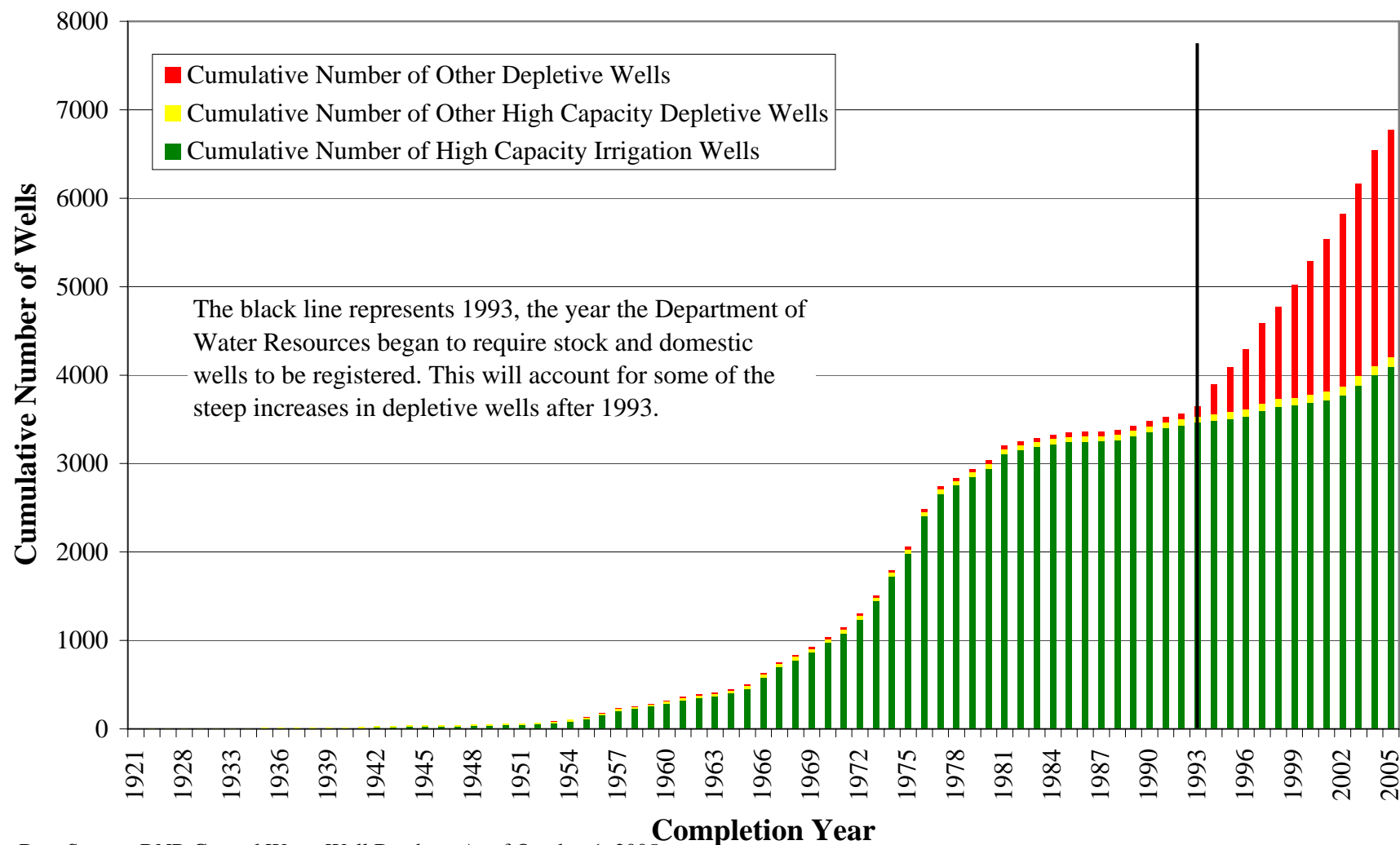


Data Source: DNR Ground Water Well Database As of October 1, 2005

Figure LN-20

By Shuhai Zheng, 12/9/2005

Cumulative Number of Depletive Wells by Completion Date Niobrara River Basin Below Mirage Flats Diversion



Data Source: DNR Ground Water Well Database As of October 1, 2005

Figure LN-21

By Shuhai Zheng, 12/9/2005

Table LN-3. Average Irrigated Acreage 1950-2003 for Counties Fully or Partially in the Niobrara River Basin below
Mirage Flats Diversion

County Name	Estimated Average Irrigated Acreage by County						
	<i>Percent of County in Niobrara Basin</i>	<i>1950-1959</i>	<i>1960-1969</i>	<i>1970-1979</i>	<i>1980-1989</i>	<i>1990-1999</i>	<i>2000-2003</i>
Antelope	18	3140	14709	89076	160910	184990	213225
Boyd	100	151	621	3593	5820	5740	4600
Brown	60	1995	10633	46396	52650	49940	47775
Cherry	62	139	2852	19585	27460	26650	25350
Dawes	12	950	5274	7678	15570	14150	11125
Garden	<1	3798	9278	19728	31360	31940	31825
Holt	43	2746	27950	133669	195120	210960	220725
Keya Paha	100	190	1336	9689	8690	9810	10475
Knox	39	677	3535	17682	35420	43430	49875
Morrill	<1	11600	31720	59118	85260	97870	107750
Rock	22	115	1646	27958	38410	37150	36825
Sheridan	63	4211	15936	30268	52550	53330	48800
Total		29712	125490	464440	709220	765960	808350
% Change from Previous 10 Years			322.35%	270.10%	52.70%	8.00%	5.53%

* The percentage is the percentage of the county area which is in the Niobrara Basin. It does not necessarily represent the percentage of irrigated county acreage in the Niobrara River Basin.

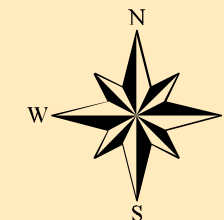
Data Source: <http://www.usda.gov/nass/>, National Agricultural Statistics Service, U.S. Department of Agriculture



Planning and Assistance Division

Ground Water-level Changes Pre-development to 2005

NIOBRARA RIVER BASIN BELOW MIRAGE FLATS DIVERSION



Surface Water Features

Niobrara Basin

Ground Water Level Changes

-10.00 to -19.99 feet

-5.00 to -9.99 feet

5.00 to 9.99 feet

10.00 to 19.99 feet

20.00 to 29.99 feet

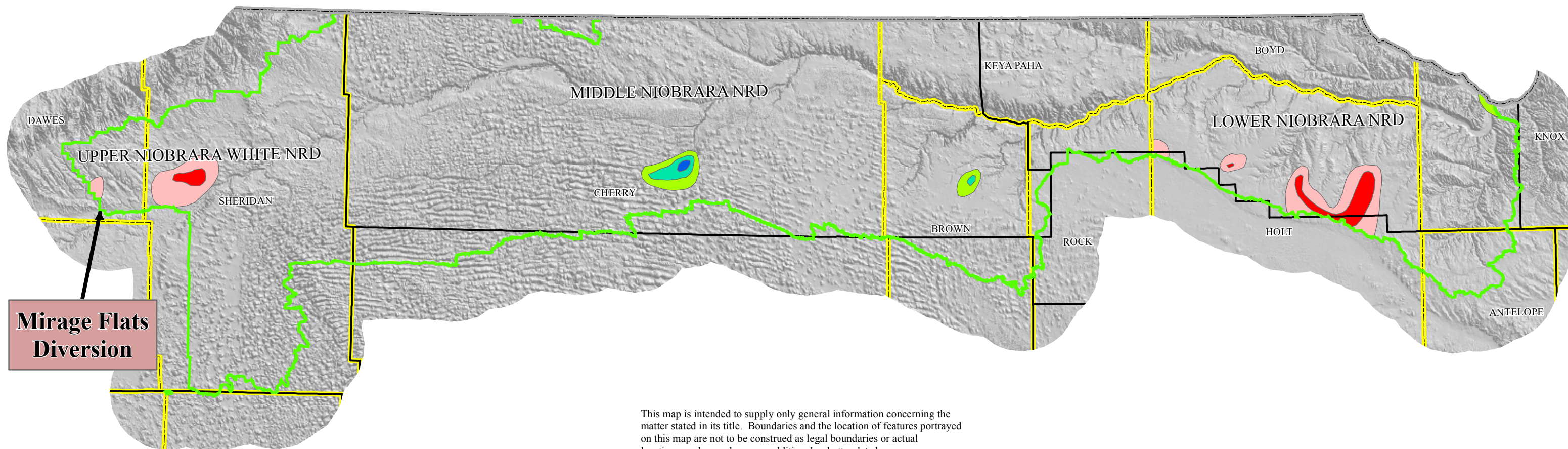
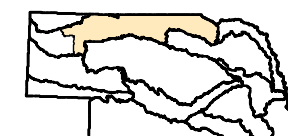
Cultural Features

County Boundary

State Boundary

NRD Boundary

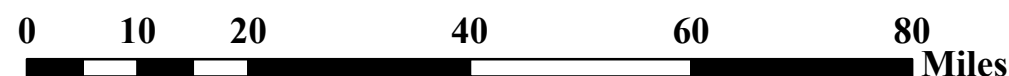
Location Map



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Ground water changes information provided by the UNL Conservation and Survey Division: <http://csd.unl.edu/general/gis-datasets.asp>.

Figure LN-22.



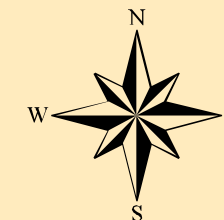
Base map produced by Josh Lear, February 4, 2005
Base map approved February 4, 2005
Ground water-level Changes added by Shuhai Zheng, October 13, 2005



Planning and Assistance Division

Hydrograph Locations

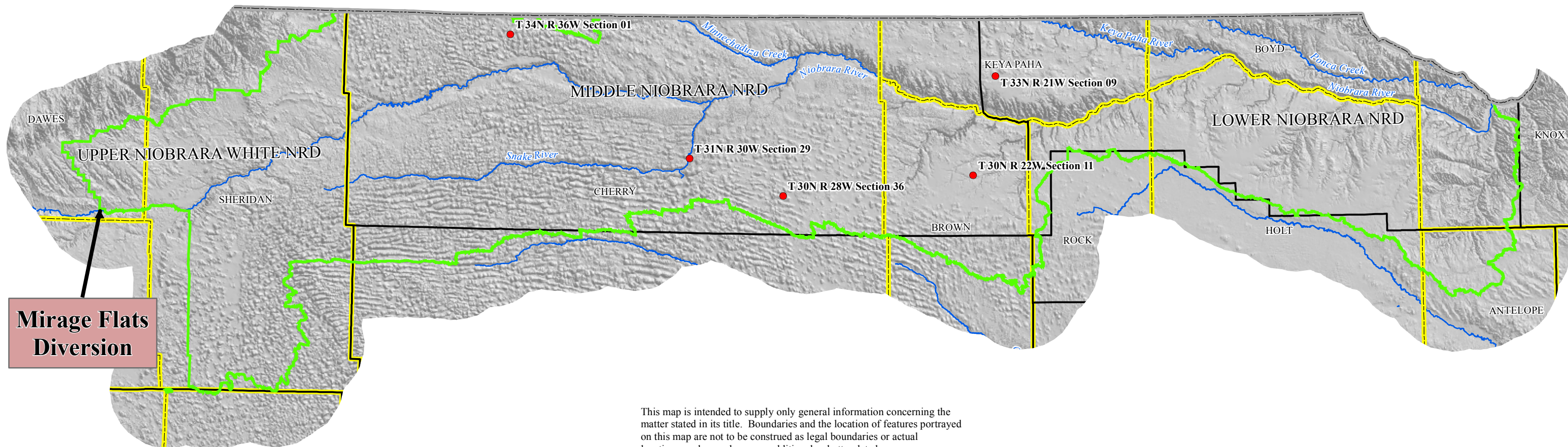
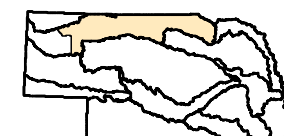
NIOBRARA RIVER BASIN BELOW MIRAGE FLATS DIVERSION



Explanation

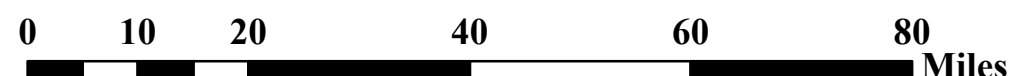
- | | |
|--------------------|--------------------------|
| ● Well Hydrographs | Cultural Features |
| □ Niobrara Basin | --- County Boundary |
| | --- State Boundary |
| | — NRD Boundary |

Location Map



This map is intended to supply only general information concerning the matter stated in its title. Boundaries and the location of features portrayed on this map are not to be construed as legal boundaries or actual locations, and may change as additional or better data become available. User assumes all risks associated with interpretations of this map beyond its intended purpose.

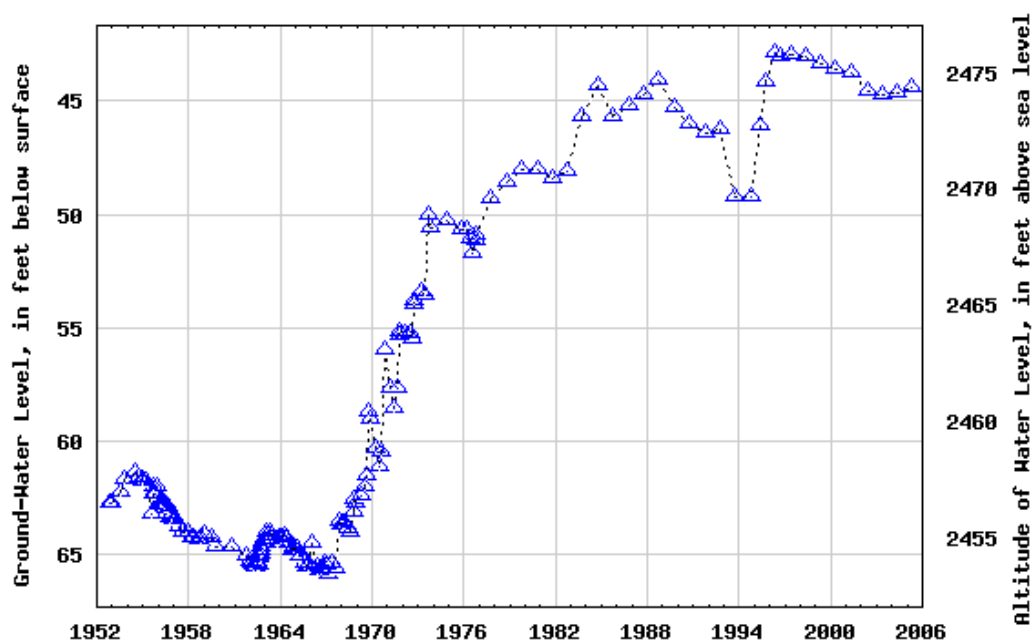
Figure LN-23.



Base map produced by Josh Lear, February 4, 2005
Base map approved February 4, 2005
Precipitation gages map produced by Kevin Schwartzman, November 2, 2005.



USGS 423527099521501 30N 22W11BB 1



Provisional Data Subject to Revision

Brown County, Nebraska

Hydrologic Unit Code 10150004

Latitude 42°35'27", Longitude 99°52'15" NAD27

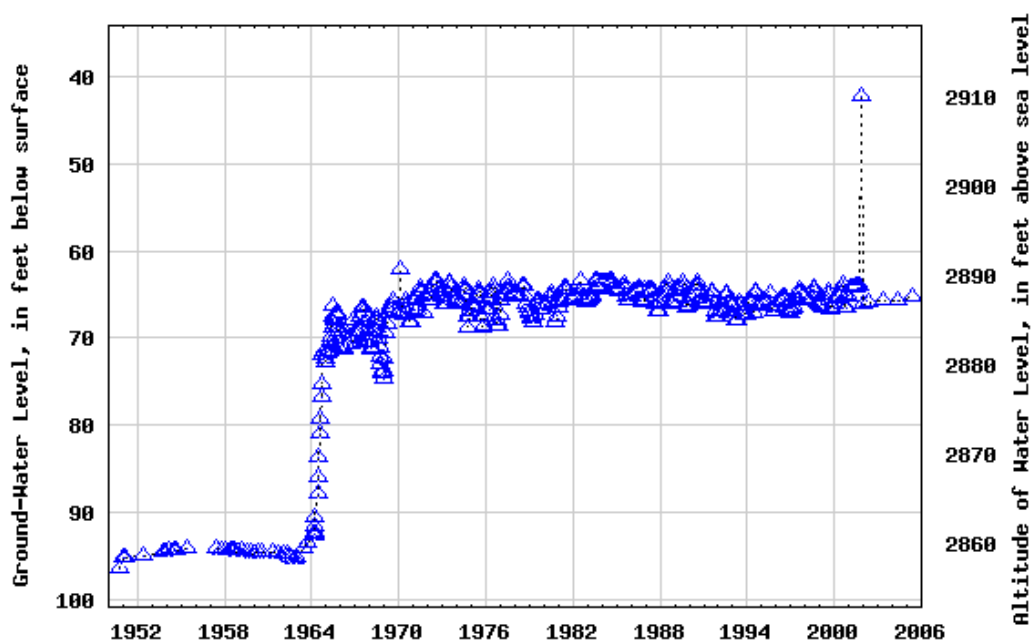
Land-surface elevation 2,519.00 feet above sea level NGVD29

The depth of the well is 94.0 feet below land surface. This well is completed in the QUATERNARY SAND DEPOSITS (112SDGV) local aquifer.

Figure LN-24



USGS 423749100515501 31N 30W29CA 1



Provisional Data Subject to Revision

Cherry County, Nebraska

Hydrologic Unit Code 10150005

Latitude 42°37'49", Longitude 100°51'55" NAD27

Land-surface elevation 2,952.9 feet above sea level NGVD29

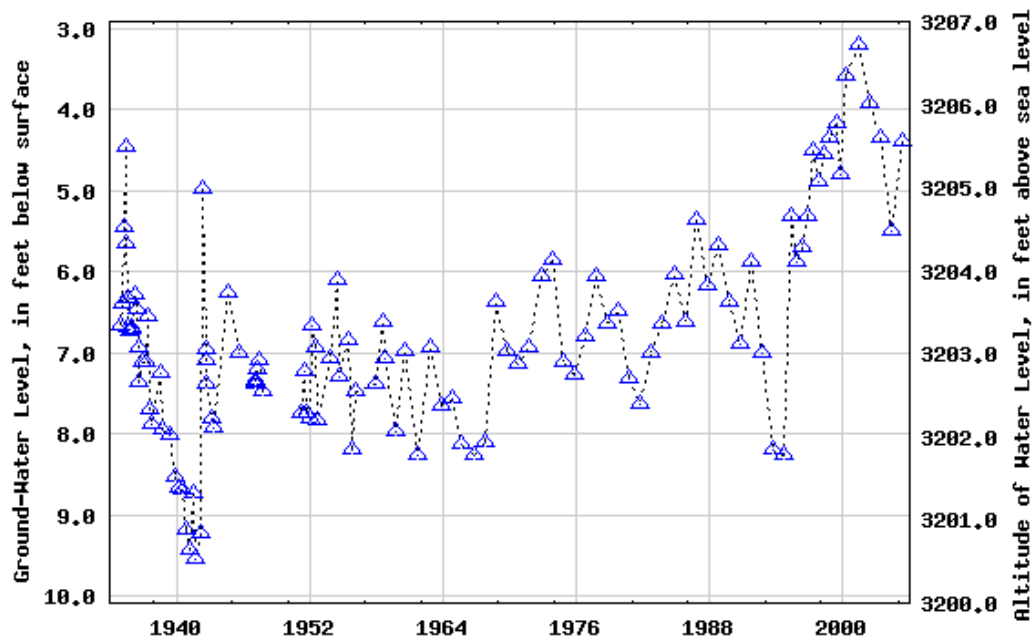
The depth of the well is 105 feet below land surface.

This well is completed in the TERTIARY OGALLALA GROUP DEPOSITS (112SDGV) regional aquifer.

Figure LN-25



USGS 425636101300901 34N 36W 1DC 1



Provisional Data Subject to Revision

Cherry County, Nebraska

Hydrologic Unit Code 10150003

Latitude 42°56'36", Longitude 101°30'09" NAD27

Land-surface elevation 3,210 feet above sea level NGVD29

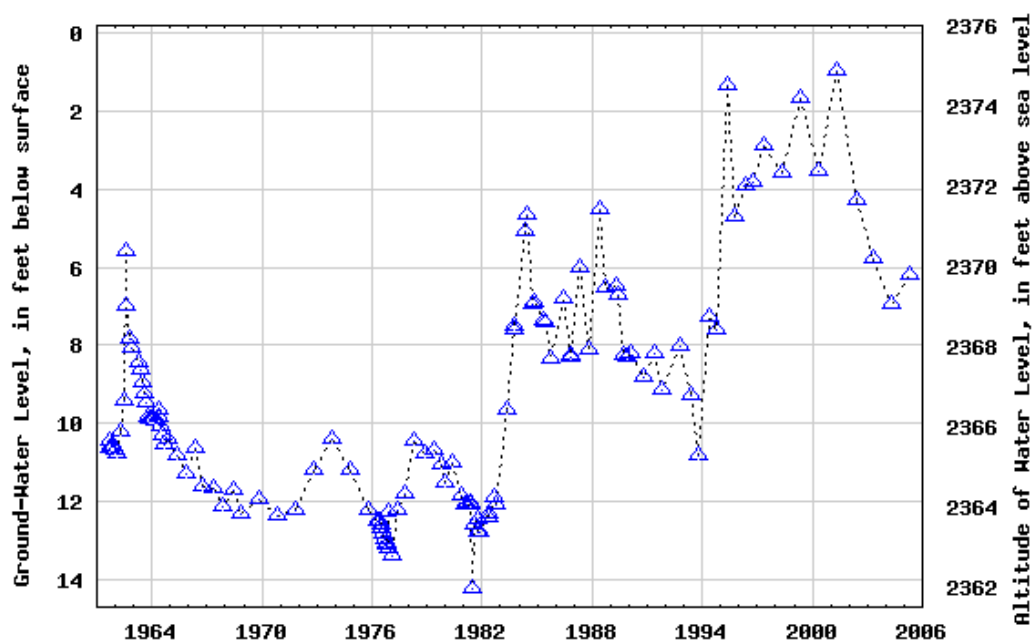
The depth of the well is 21.0 feet below land surface.

This well is completed in the QUATERNARY SAND DEPOSITS (112SDGV) local aquifer.

Figure LN-26



USGS 425050099472001 33N 21W 9AD 1



Provisional Data Subject to Revision

Keya Paha County, Nebraska

Hydrologic Unit Code 10150006

Latitude 42°50'50", Longitude 99°47'20" NAD27

Land-surface elevation 2,376.00 feet above sea level NGVD29

The depth of the well is 30.0 feet below land surface.

This well is completed in the TERTIARY OGALLALA GROUP DEPOSITS (112SDGV) regional aquifer.

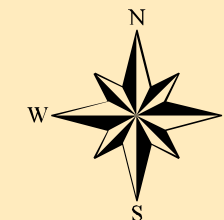
Figure LN-27



Planning and Assistance Division

Stream Gages

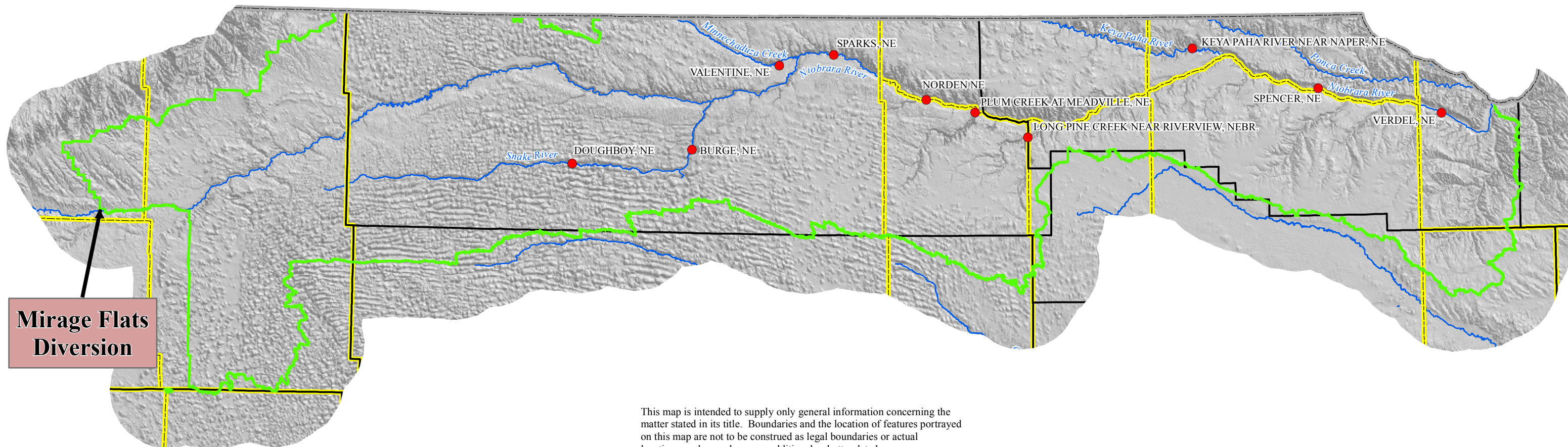
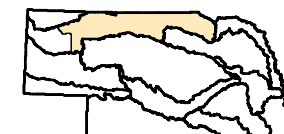
NIOBRARA RIVER BASIN BELOW MIRAGE FLATS DIVERSION



Explanation

- Niobrara Basin Cultural Features
- Stream Gages
- County Boundary
- State Boundary
- NRD Boundary

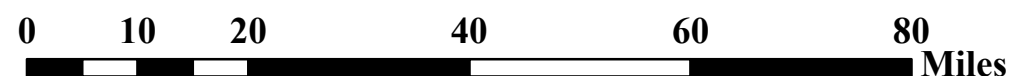
Location Map



Mirage Flats
Diversion

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Figure LN-28.



Base map produced by Josh Lear, February 4, 2005
Base map approved February 4, 2005
Stream gages map produced by Jeff Shafer, October 20, 2005.

Figure LN-29. Annual Flows, Minnechaduza Creek near Valentine.

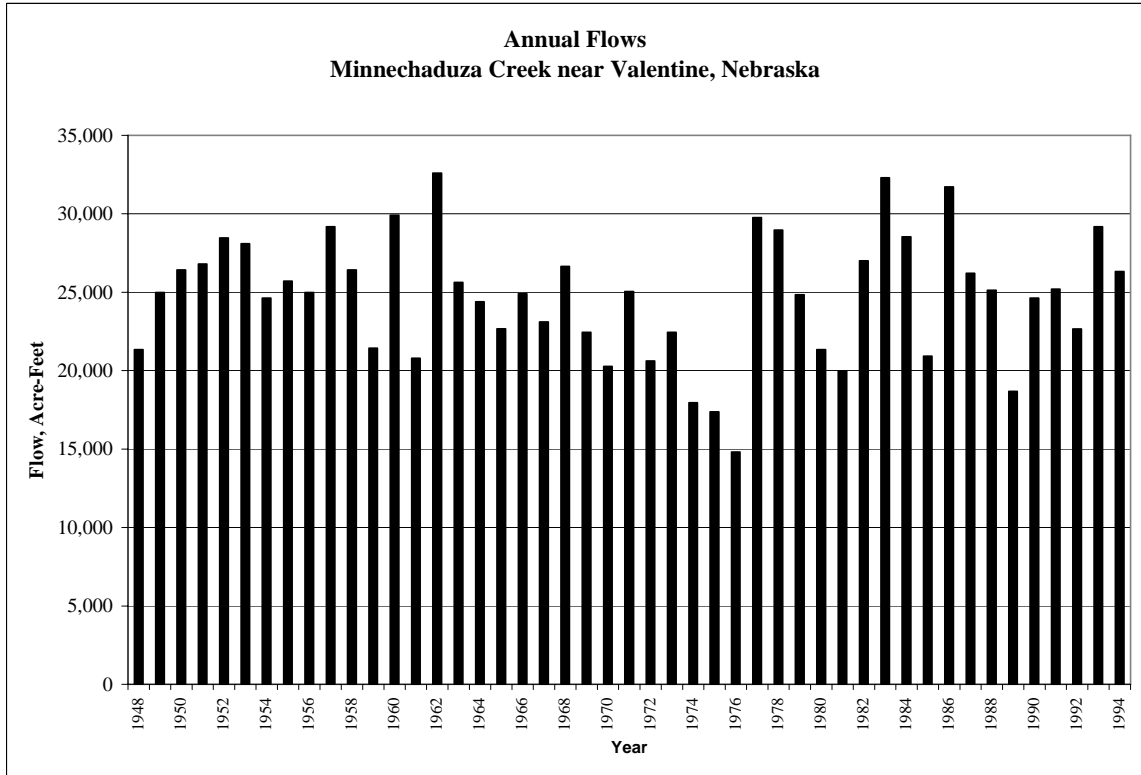


Figure LN-30. Annual Flows, Snake River at Doughboy.

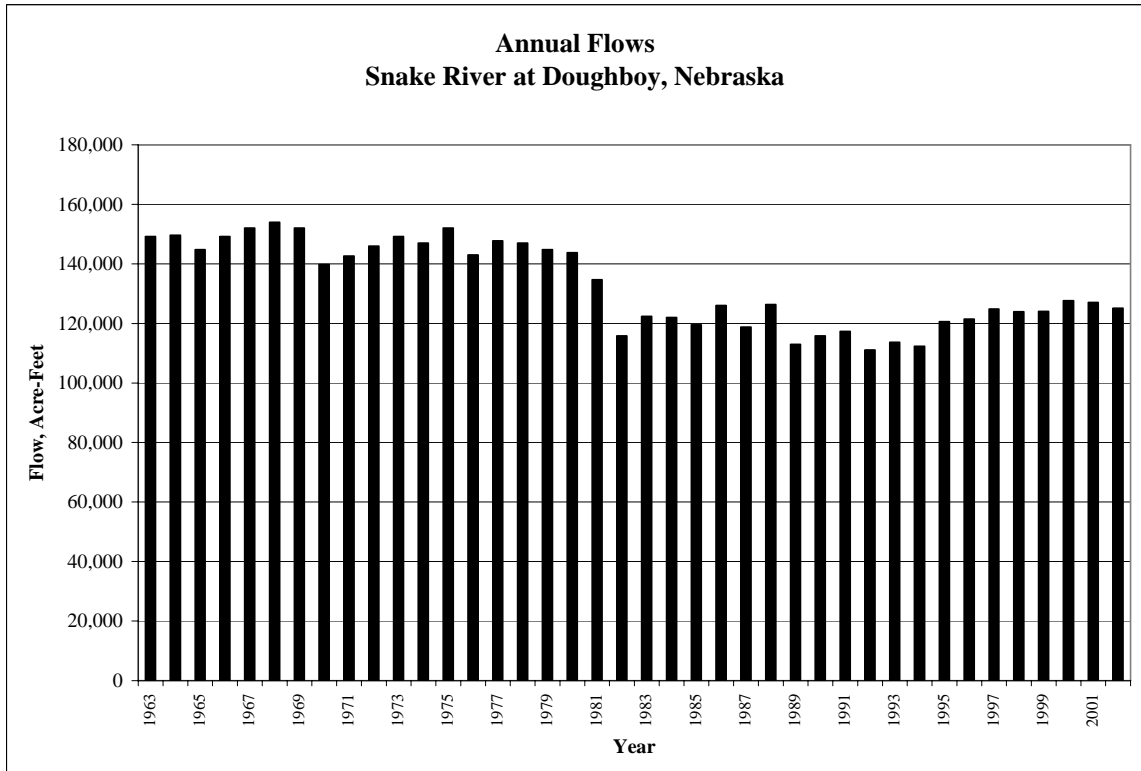


Figure LN-31. Annual Flows, Snake River near Burge.

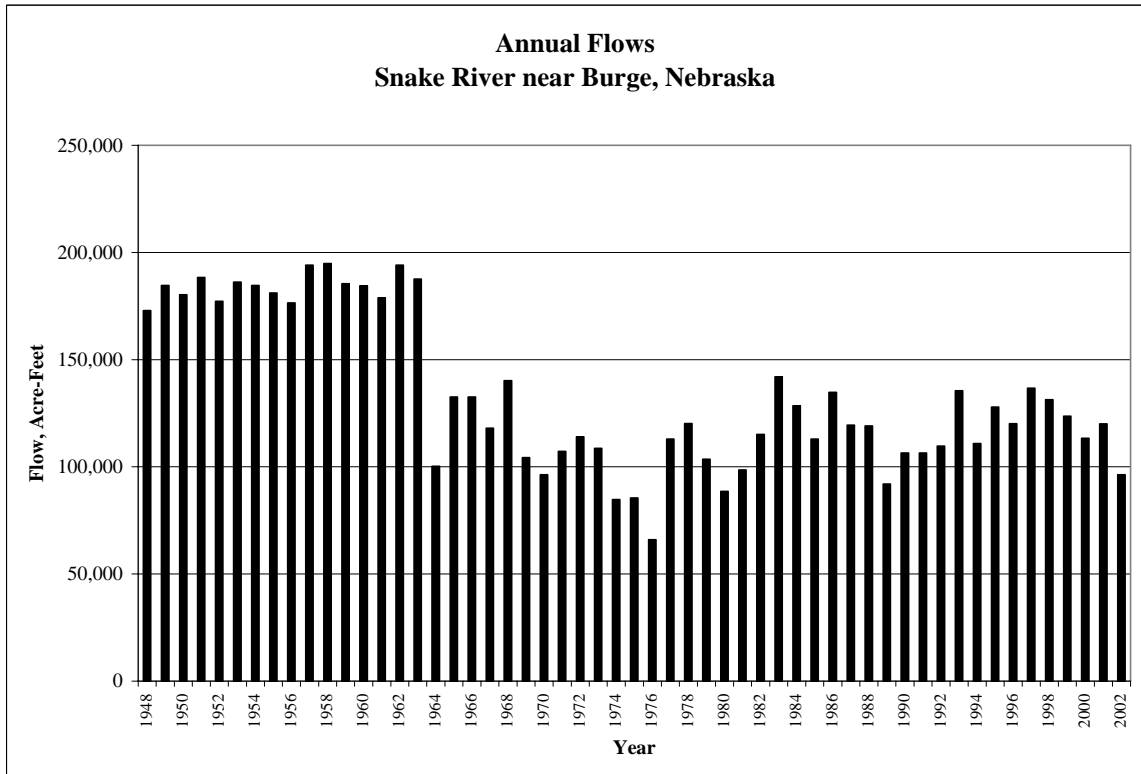


Figure LN-32. Annual Flows, Keya Paha River near Naper.

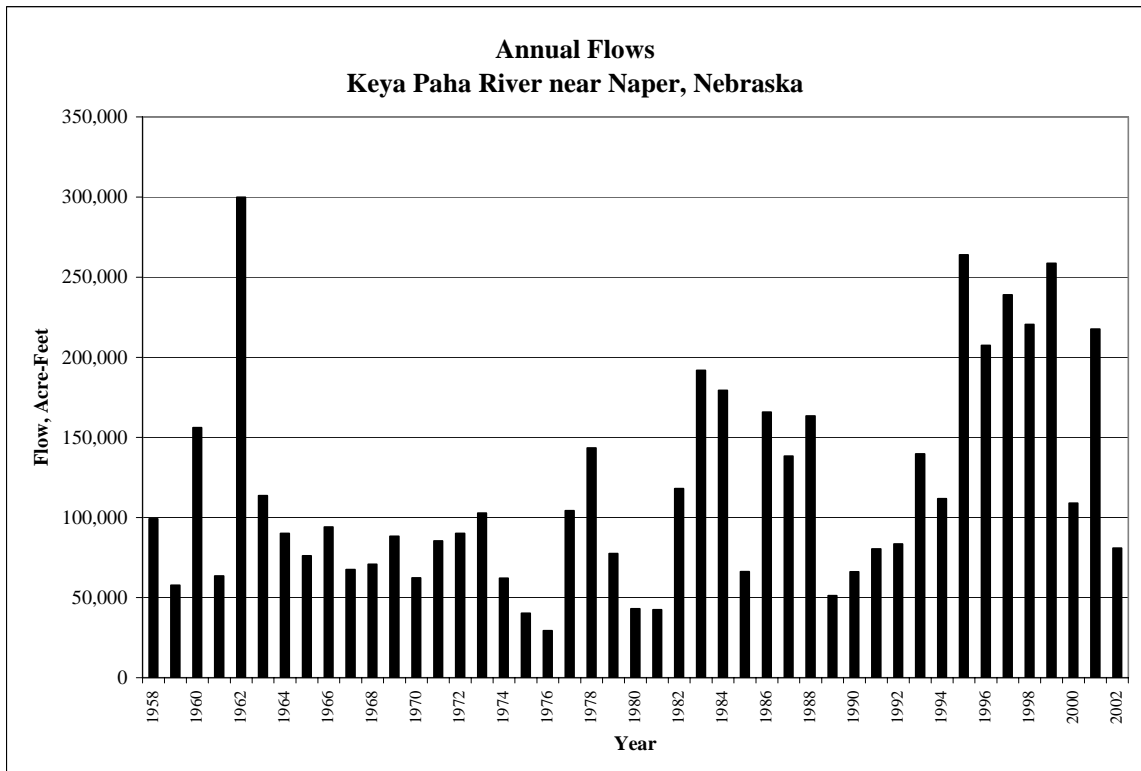


Figure LN-33. Annual Flows, Plum Creek at Meadville.

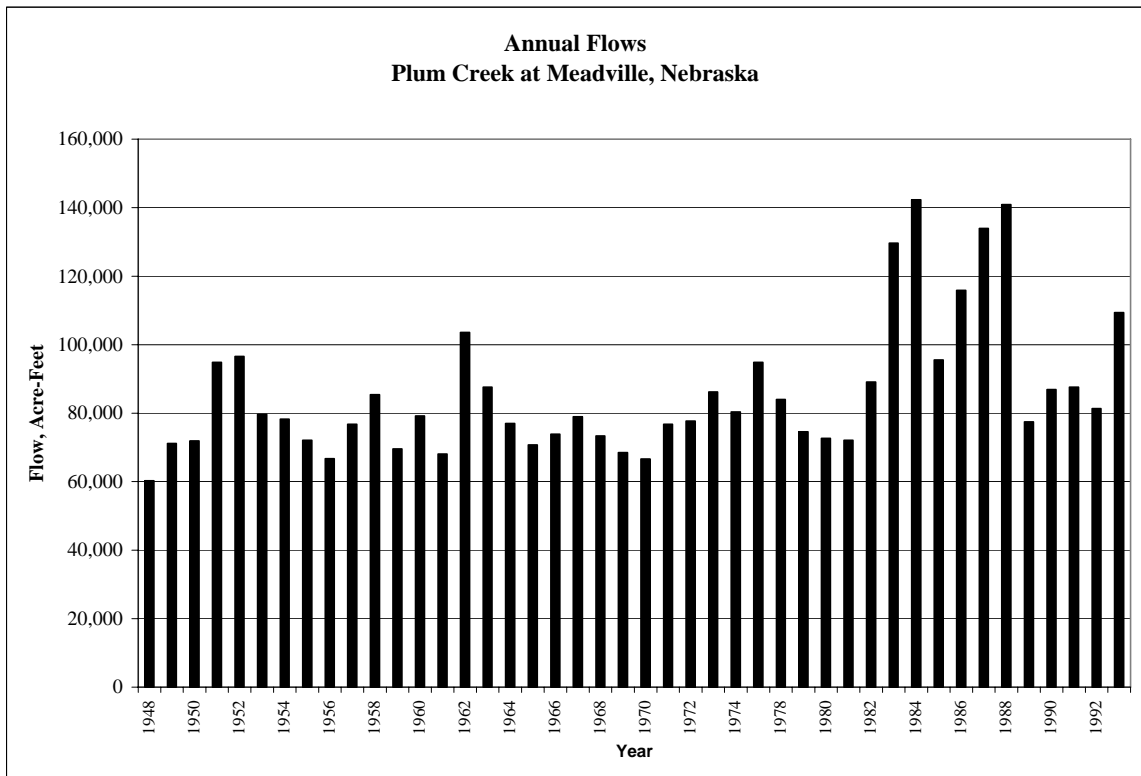


Figure LN-34. Annual Flows, Long Pine Creek near Riverview.

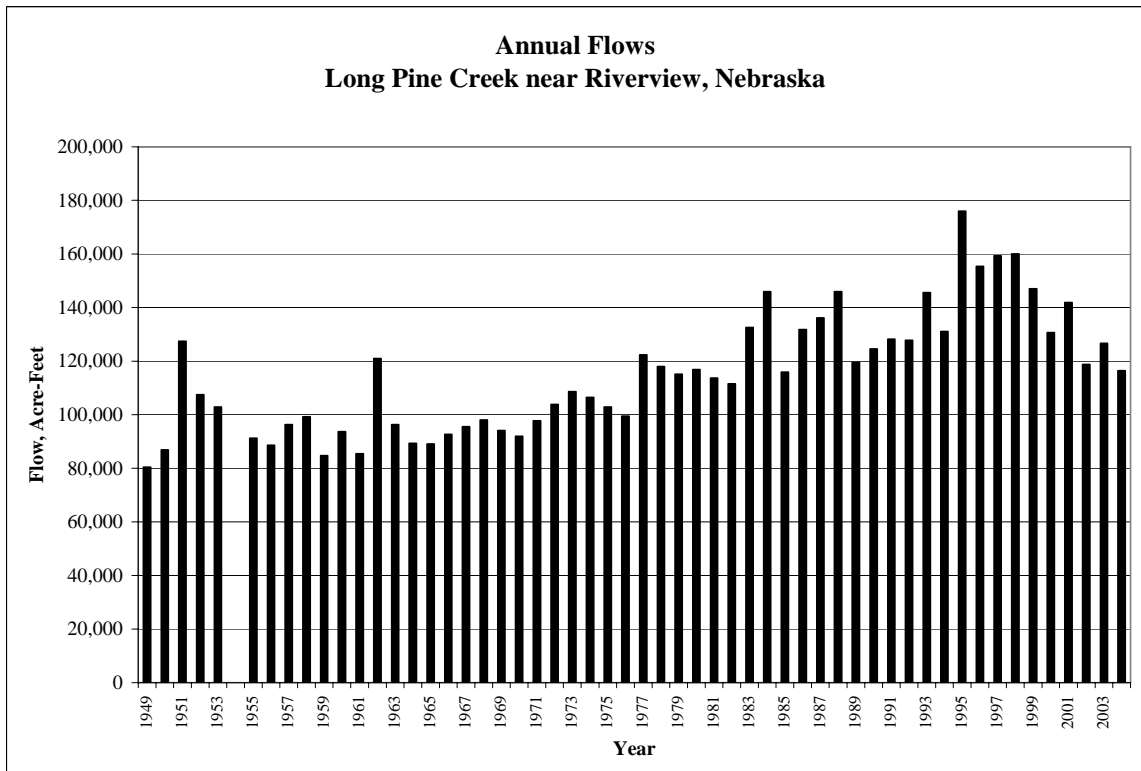


Figure LN-35. Annual Flows, Niobrara River near Sparks.

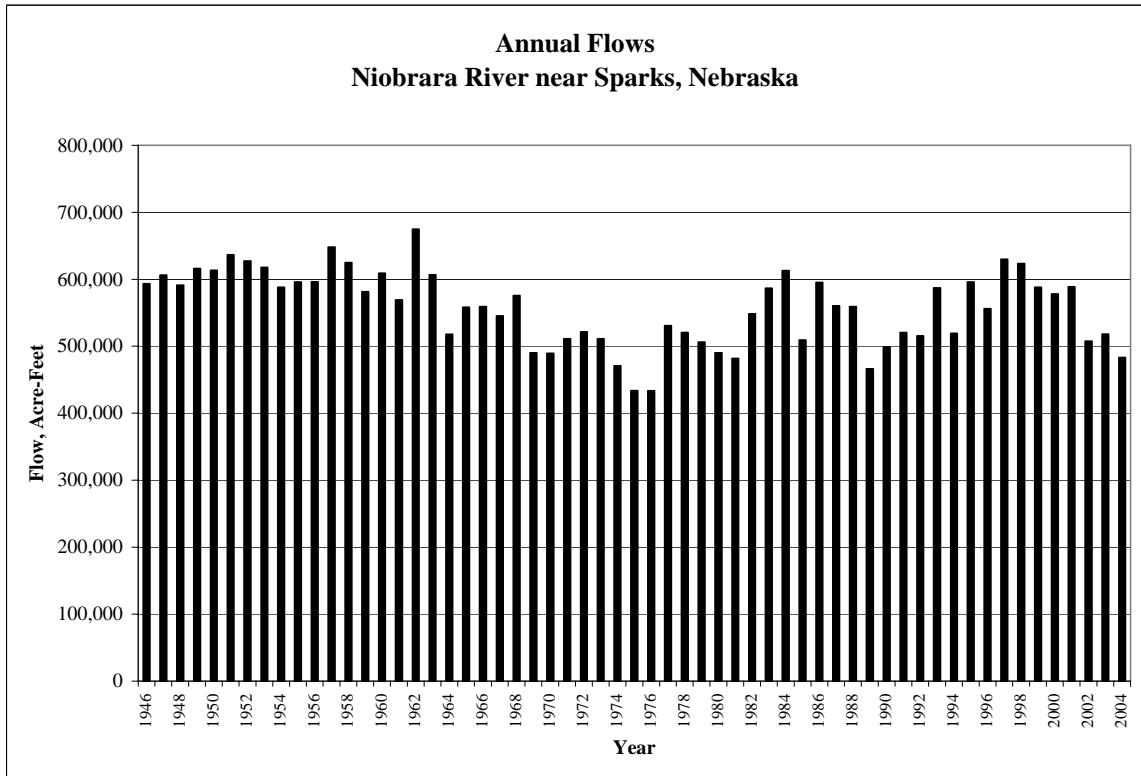


Figure LN-36. Annual Flows, Niobrara River near Norden.

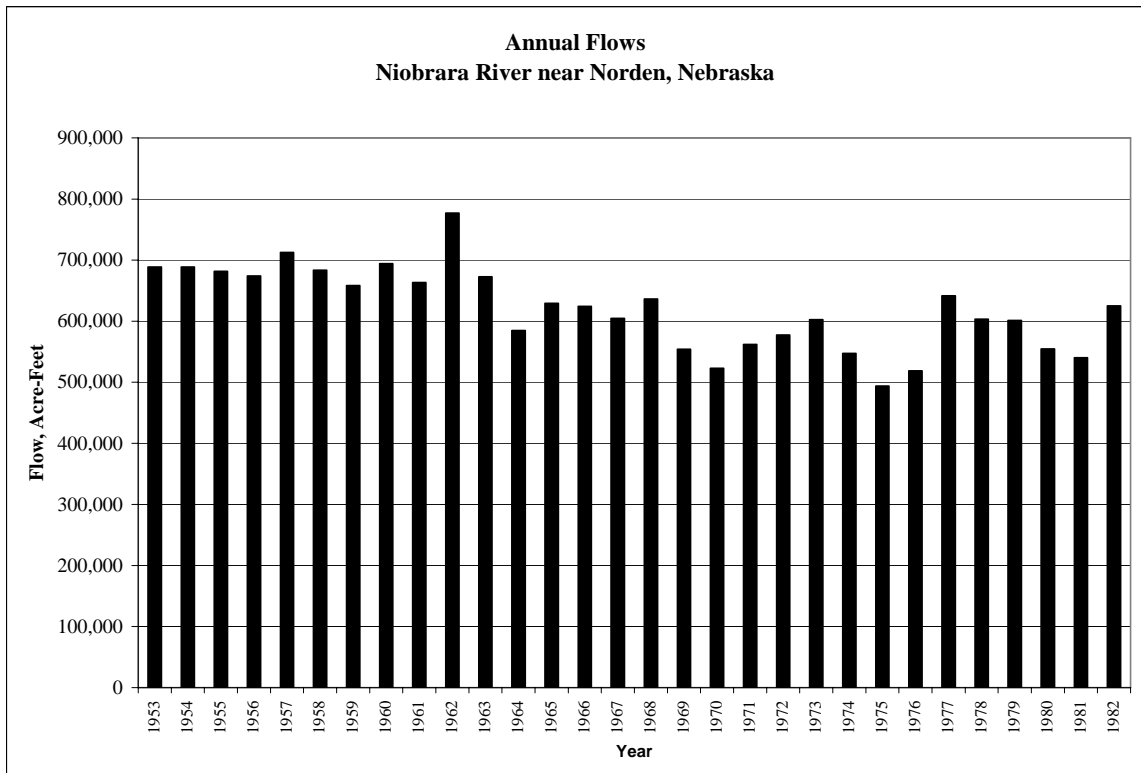


Figure LN-37. Annual Flows, Niobrara River near Spencer.

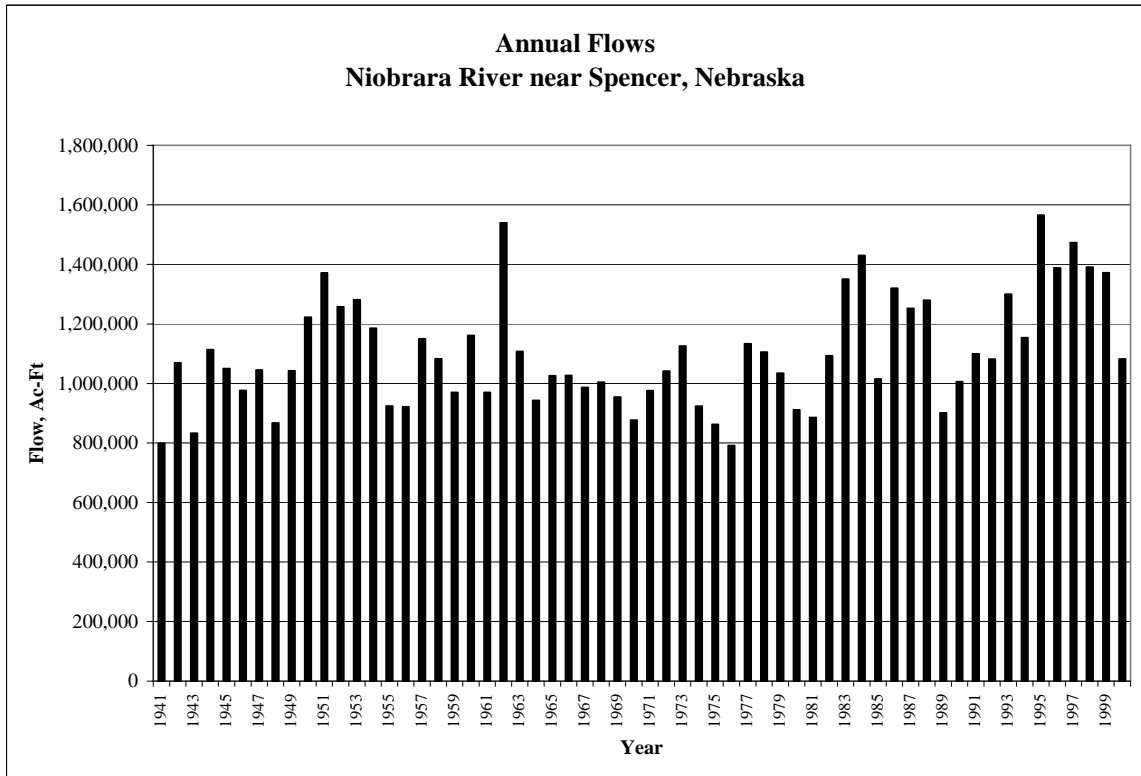
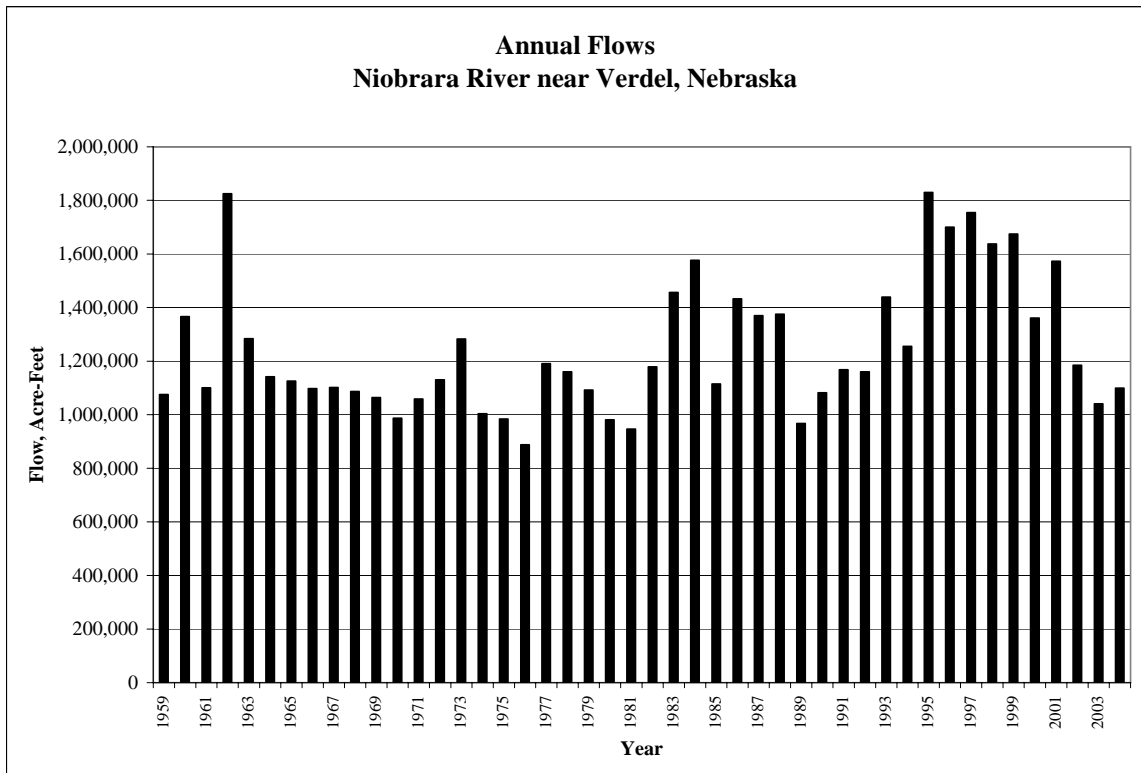


Figure LN-38. Annual Flows, Niobrara River near Verdel.



Cumulative Number of Surface Water Appropriations in Niobrara River Basin Below Mirage Flats Diversion by Use

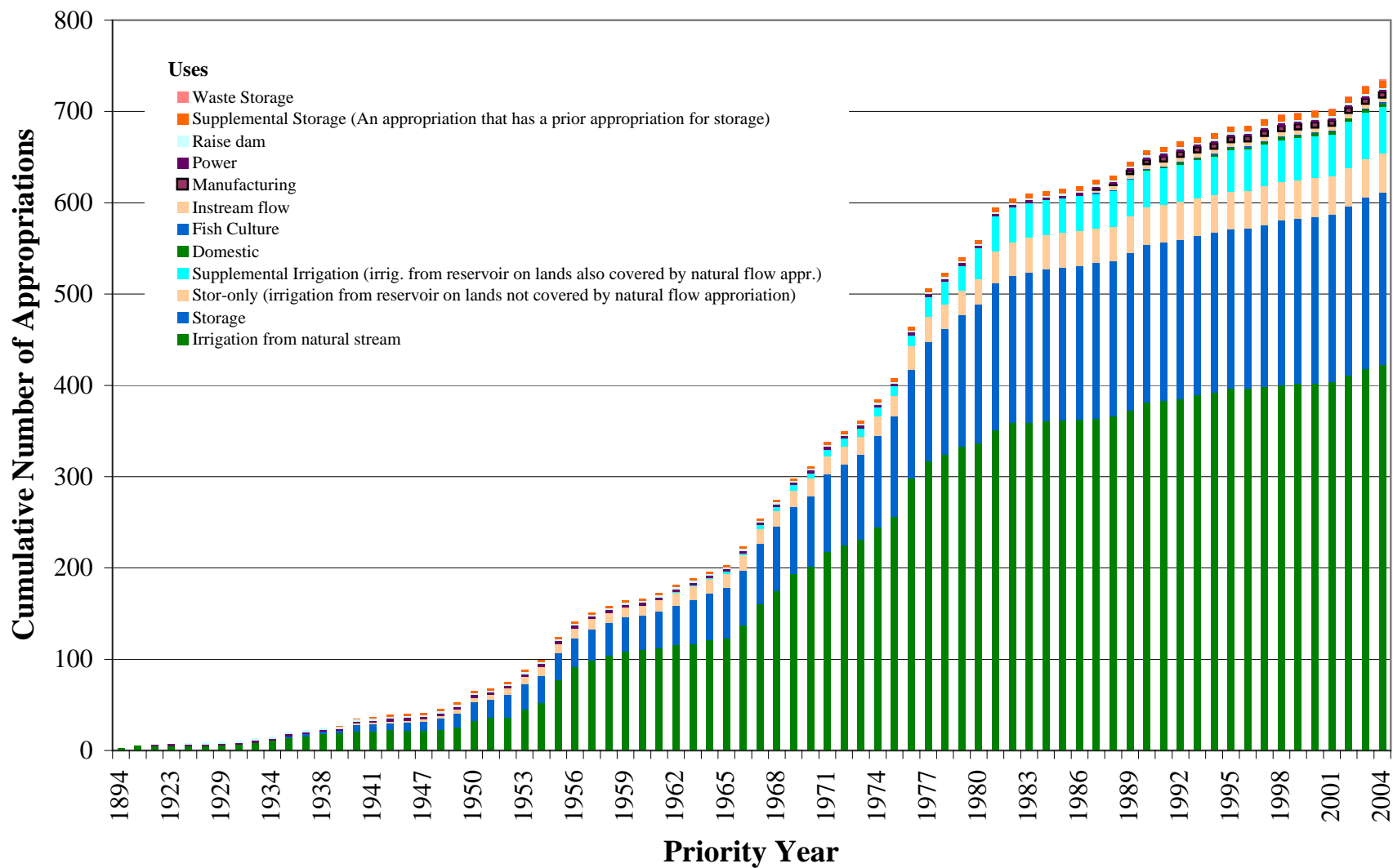


Figure LN-39

Cumulative Surface Water Appropriated Acres in Niobrara River Basin Below Mirage Flats Diversion

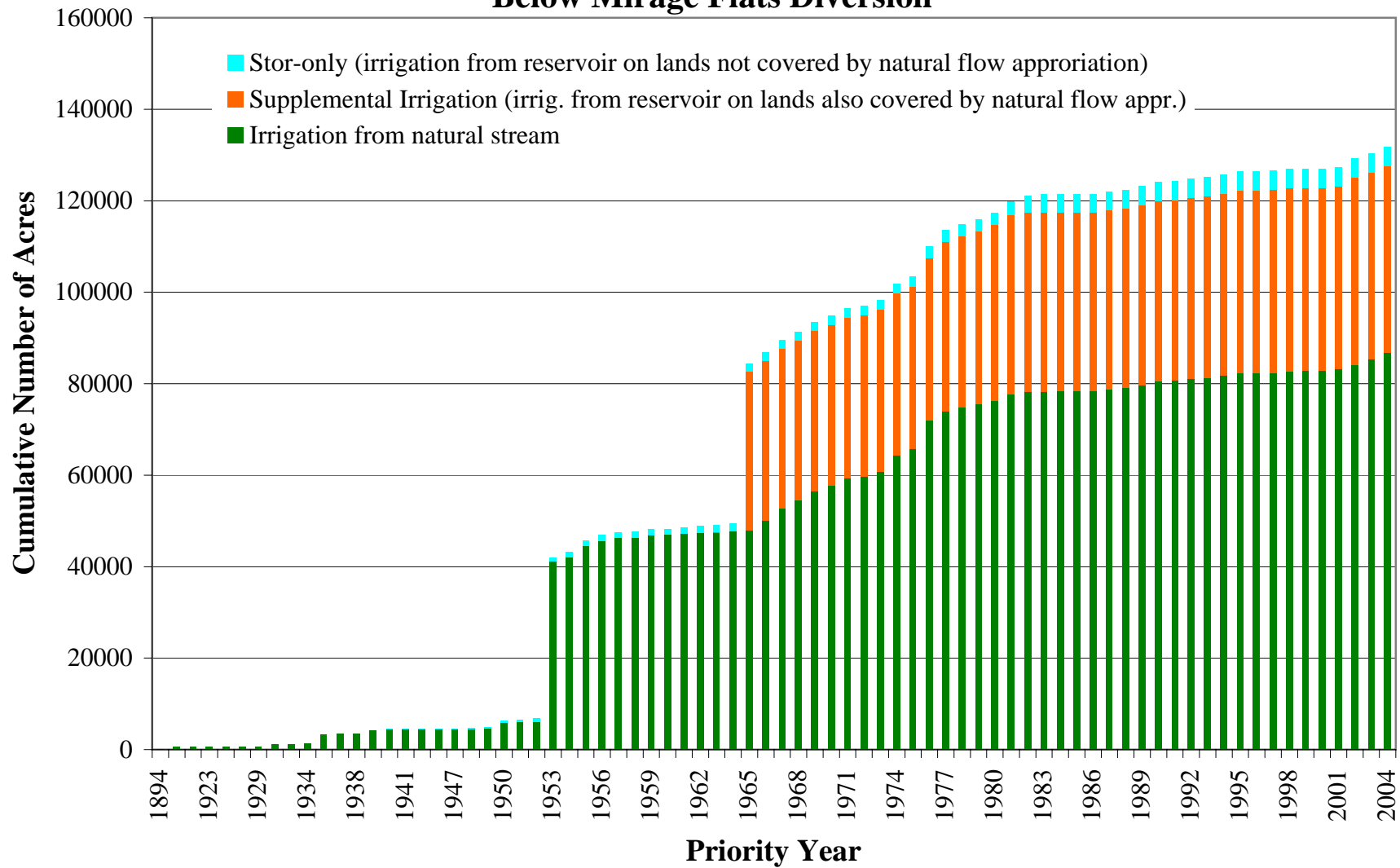


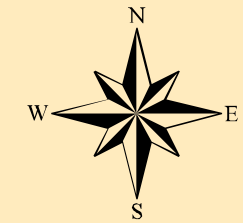
Figure LN-40



Planning and Assistance Division

Surface Water Points of Diversion

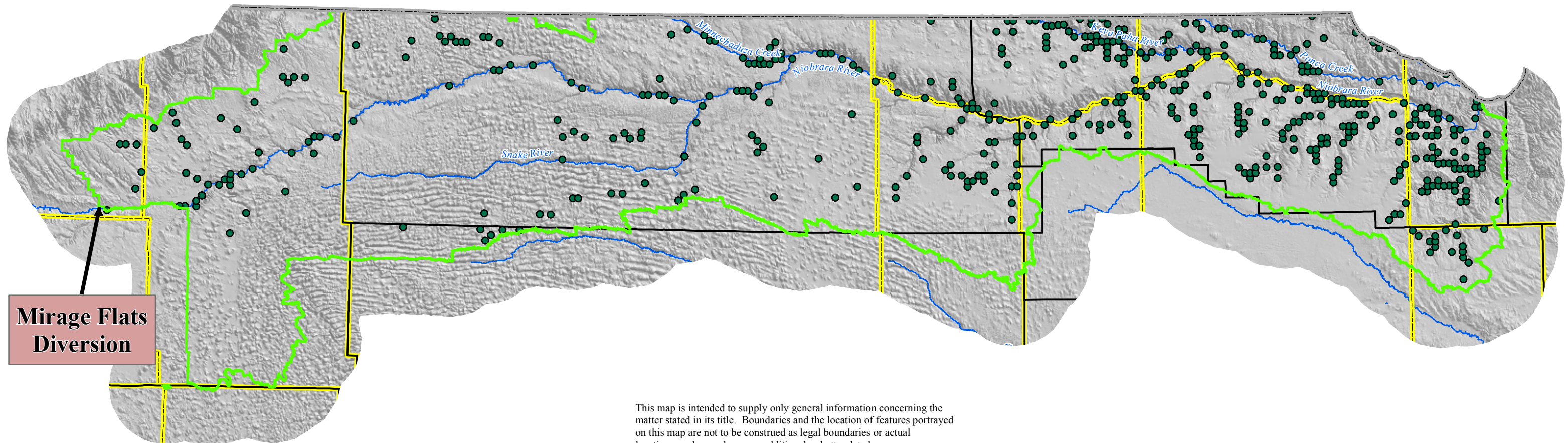
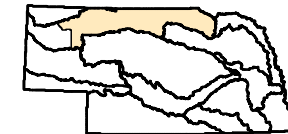
NIOBRARA RIVER BASIN BELOW MIRAGE FLATS DIVERSION



Explanation

- | | |
|---------------------|--------------------------|
| Niobrara Basin | Cultural Features |
| Points of Diversion | County Boundary |
| | State Boundary |
| | NRD Boundary |

Location Map

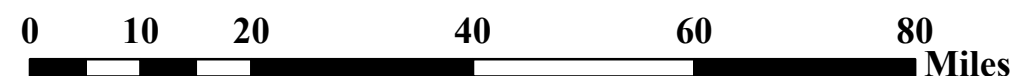


**Mirage Flats
Diversion**

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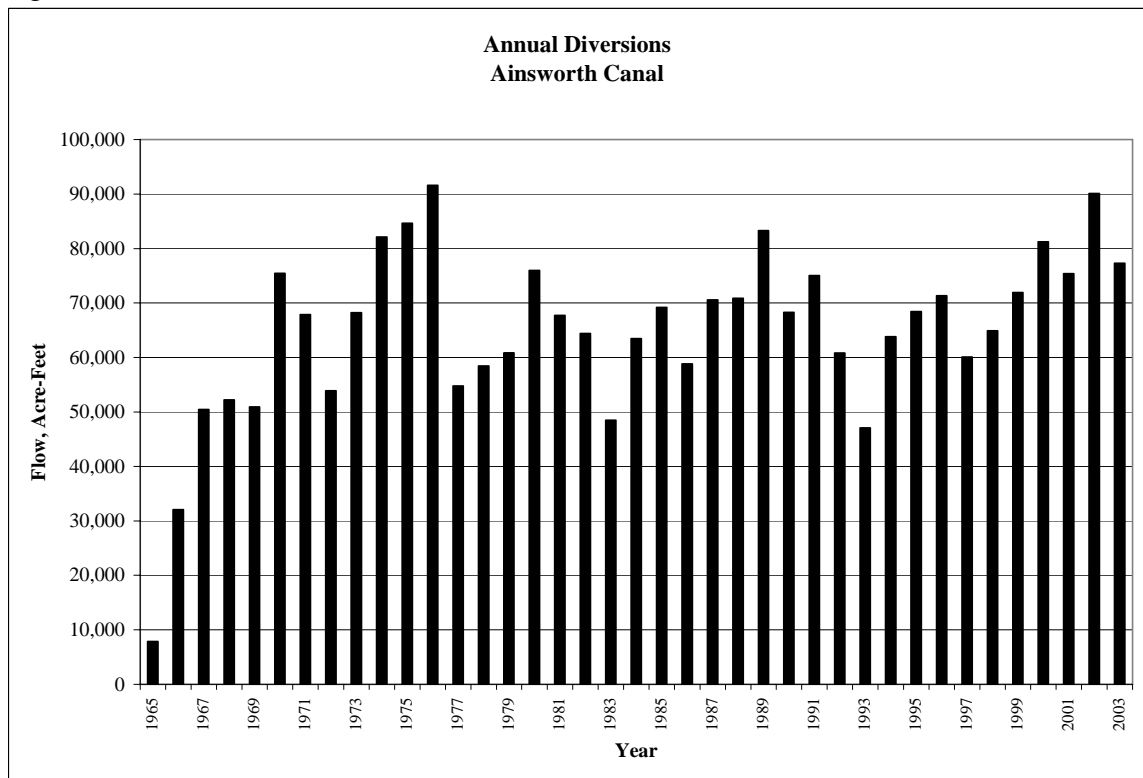
Points of diversions were derived from legal descriptions in the DNR Water Rights Database, as of January 2005, and were plotted to the nearest one-mile section center on this map.

Figure LN-41.



Base map produced by Josh Lear, February 4, 2005
Base map approved February 4, 2005
Points of diversion map produced by Shuhai Zheng, October 13, 2005.

Figure L-42 Annual Diversions, Ainsworth Canal.

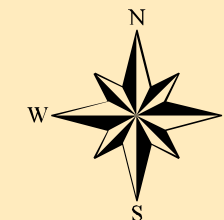




Planning and Assistance Division

Corn Irrigation Requirement

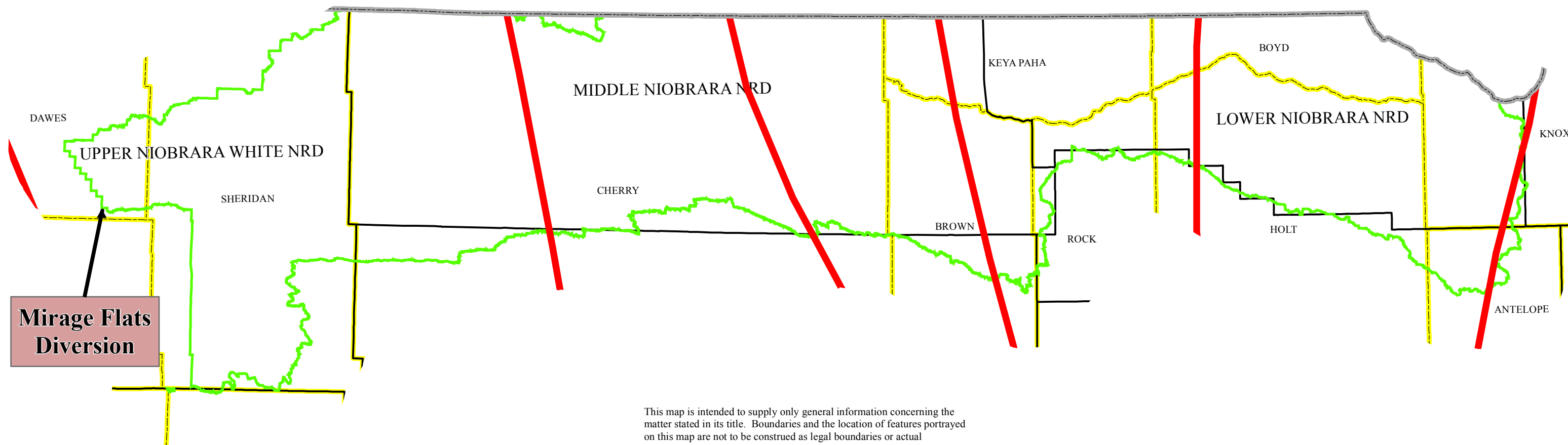
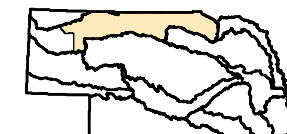
NIOBRARA RIVER BASIN BELOW MIRAGE FLATS DIVERSION



Explanation

- | | |
|-----------------------------|--------------------------|
| Niobrara Basin | Cultural Features |
| Corn Irrigation Requirement | County Boundary |
| | State Boundary |
| | NRD Boundary |

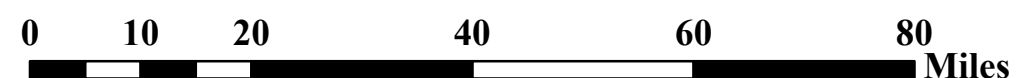
Location Map



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**Mirage Flats
Diversion**

Figure LN-44.



Base map produced by Josh Lear, February 4, 2005
Base map approved February 4, 2005
Transmissivity map produced by Kevin J. Schwartman, December 7, 2005

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- Citation Keech, C.F., 1957, Water levels in observation wells in Nebraska during 1956: U.S. Geological Survey Open File Report 57-61,123p.
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- Citation Keech, C.F., 1964, Ground-water resources of Mirage Flats, Nebraska: U.S. Geological Survey Water-Supply Paper 1779-BB, 36 p.
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Citation

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